

# The Korean Prediction Model for Adolescents' Future Smoking Intentions

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**Objectives:** The purpose of this study was to develop a prediction model for future smoking intention among Korean adolescents aged 13 to 15 in order to identify the high risk group exposed to future smoking.

**Methods:** The data was collected from a total of 5940 students who participated in a self-administrated questionnaire of a cross-sectional school-based survey, the 2004 Korea Global Youth Tobacco Survey. Chi-square tests and logistic regression analyses were carried out to identify the relevant determinants associated with intentions of adolescents' future smoking. Receiver Operation Characteristic (ROC) assessment was applied to evaluate the explanation level of the developed prediction model.

**Results:** 8.4% of male and 7.2% of female participants show their intentions of future smoking. Among non-smoking adolescents; who have past smoking experience [odds ratio (OR) 2.73; 95% confidence interval (CI) 1.92-3.88]; who have intentions of smoking when close friends offer a cigarette (OR 31.47; 95% CI = 21.50 - 46.05); and who have friends that are mostly smokers (OR 5.27; 95% CI = 2.85 - 9.74) are more likely to be smokers in the future. The prediction model developed from this study consists of five determinants; past smoking experience; parents smoking status; friends smoking status; ownership of a product with a cigarette brand logo; and intentions of smoking from close friends' cigarette offer. The area under the ROC curve was 0.8744 (95% CI=0.85-0.90) for current non-smokers.

**Conclusions:** For efficiency, school-based smoking prevention programs need to be designed to target the high risk group exposed to future smoking through the prediction model developed by the study, instead of implementing the programs for all the students.

**Key words:** Adolescent, Smoking, Intention, Schools  
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## INTRODUCTION

The prevalence of adolescents' smoking in South Korea has started to drop since 2000, although it has been one of the highest in the world [1,2]. According to the Gallup survey, the smoking prevalence of the Korean male high school students and female students aged 16 to 18 reached a peak in 1997 and 2000 with 35.3% and 10.7%. However, in 2007 the rates significantly decreased to 16.2% for male and to 5.2% for female [3]. It is estimated that this downward trend in the smoking rate among adolescents was partly due to the National Health Promotion Act, enacted in 1995. Yet, despite of the historically unique tobacco control regulation and the efforts of tobacco control advocates, the decline of the adolescent smoking rate has slowed down since 2004. In addition, the smoking rate among male middle school students aged 13 to 15 has risen from 2.4% in 2004 to 5.7% in 2008, and the rate of female students has

increased from 1.7% to 3.2% in the same period [2]. Thus, due to this recent upward trend of smoking prevalence, middle school students, in particular, need more attention.

Previous analyses indicate the impact of adolescents' smoking upon their health and later behavior. Those who initiate cigarette smoking early in his/her life are at a greater risk of health problems [4] and a third of those who started smoking as a teenager would die due to tobacco-related diseases, such as lung cancer and cardiovascular diseases [5]. Moreover, adolescent smoking is one of the main causes of social deviant behaviors, such as drug abuse and anti-social behavior [6,7]. Therefore, in order to protect adolescents from smoking, one of the common interventions widely used has been a school-based smoking prevention program. A previous research analyzes that school-based programs are more effective than other programs which target adult smokers [8]. However, to date, the school-based

smoking prevention programs in Korea have produced mixed results, some reported as being effective and others not effective at all. A previous study explains that the reasons behind the programs' ineffectiveness are due to the regular curriculum and non-interactive delivery methods [9]. Thus, in order to overcome these problems, the present study suggests that the programs focus on the high risk students who have intentions of smoking in the future rather than the students who have less or no intention of future smoking. The high risk group exposed to future smoking among adolescents can be divided into two groups, current smoker and those that have intentions of smoking in the future. The study focuses on the latter group in order to emphasize an effective smoking prevention program, rather than the former that needs tobacco cessation intervention.

It is demonstrated that future health related behavior such as smoking is influenced by current behavioral intentions [10]. This means that those who currently have intentions of smoking in the future are more likely to smoke in the future. Hence an investigation into current intentions of future smoking can be a useful tool to select the high risk group exposed to future smoking.

The purpose of this study is to identify the relevant determinants of future smoking intentions among the non-smoking Korean adolescents aged 13 to 15 and to develop a prediction model for the high risk group exposed to future smoking.

## METHOD

### I. Subjects

The study used the 2004 Korea Global Youth Tobacco Survey (GYTS) carried out among middle school students, as the primary data. The survey was a cross-sectional school-based survey, which employed a two-stage cluster sample design to produce a nationally representative sample of middle school students aged 13 to 15. For the sampling frame, each 75 schools located in Seoul, six Metropolitan cities (Pusan, Gwangju, Ulsan, Incheon, Daegu and Daejeon) and seven Provinces (Jeollabok-do, Jeollanam-do, Gyeongsangnam-do, Gyeongsangbuk-do, Chungcheongnam-do, Chungcheongbuk-do and Gyeonggy-do) were selected and grades 1, 2, 3 were chosen with 40 or more students in each class. The first-stage sampling frame included of grades 1, 2, 3 in all the schools. Schools were selected with a probability proportion to school enrollment size. The second sampling stage consisted of systematic equal probability sampling of classes from

each school that participated in the survey. The overall response rate was 87.7%, with 92.0% (69 of the 75 sampled schools) school response rate and 95.3% (5940 of the 6234 sampled students) student response rate. A comprehensive description of the GYTS methodology has been described elsewhere [1,11,12].

### II. Study Design

In order to define future smoking intentions of the participants, as the dependant factor, the study analyzed the students' response to a GYTS survey question, "Do you think you will be smoking cigarettes 5 years from now?" Through reviewing the existing literature, the study also identified ten independent determinants closely related to adolescent smoking behavior, which might influence intentions of future smoking, notably; current smoking status; past smoking experience; monthly allowance; parents' smoking status; education of the smoking effects; ownership of something with a cigarette brand logo; exposure to smoking scenes in movies and videos; closest friends' smoking status; and intention of smoking from friends' cigarette offer [13-20]. The study estimated the association between the selected independent factors and the dependent factor, and then classified the factors which had explanatory links with future smoking intentions. The classified determinants were, finally, used as components for a prediction model of future smoking intentions among Korean non-smoking adolescents.

### III. Data Collection and Analysis

The survey procedures of GYTS were designed to protect the students' privacy by allowing for anonymous. The self-administrated questionnaire was used. The questionnaire contained 55 multiple-choice questions, which made up the core part of the GYTS and additionally, 30 more questions were added in the Korean version. Approximately 40 minutes were allowed for the completion of the questionnaire.

For the analysis of the collected data, Chi-square tests and logistic regression analyses, using the statistic program Stata version 8.2 (StataCorp, College Station, TX, USA), were applied to estimate the association between independent factors and future smoking intentions. Afterwards, the prediction model of the Korean adolescents' future smoking intentions was developed by classifying the identified independent factors associated with future smoking intentions. The model was then applied to the non-smoking participants

**Table 1.** Association between the participants' socio-demographic characteristics and their intentions of future smoking

Factor	Category	Sample size (n)	Future smoking intention		p-value
			No (%)	Yes (%)	
Gender	Male	2583	2365 (91.6)	218 (8.4)	p=0.077
	Female	2998	2783 (92.8)	215 (7.2)	
Grade*	1st	2085	1963 (94.2)	122 (5.8)	p<0.0001
	2nd	1754	1605 (91.5)	149 (8.5)	
	3rd	1855	1667 (89.9)	188 (10.1)	
Region†	Seoul	1892	1728 (91.3)	164 (8.7)	p=0.062
	Metropolitan cities	2125	1975 (92.9)	150 (7.1)	
	Cities and provinces	1870	1703 (91.1)	167 (8.9)	

Note: There are differences in each factor's sample size due to non-answered participants.

\* Middle school grades, † The Cities and Provinces where the participants live.

**Table 2.** Association between the selected determinants and intentions of future smoking

Factor	Category	Future smoking intention		p-value
		No (%)	Yes (%)	
Current smoking status	No	5135 (95.4)	248 (4.6)	p<0.0001
	Yes	188 (46.4)	217 (53.6)	
Ever tried smoking	No	4117 (97.7)	97 (2.3)	p<0.0001
	Yes	1161 (75.7)	373 (24.3)	
Monthly allowance	Less than \$10	1624 (95.1)	83 (4.9)	p<0.0001
	\$11 to \$30	2283 (93.0)	171 (7.0)	
	More than \$30	1471 (87.0)	220 (13.0)	
Parents' smoking status	None	2400 (94.8)	133 (5.2)	p<0.0001
	Either and both	2928 (90.0)	339 (10.0)	
Have learnt about the effects of smoking	No	2854 (91.2)	274 (8.8)	p=0.006
	Yes	2387 (93.2)	174 (6.8)	
Ownership of something with a cigarette brand logo	No	4813 (93.1)	355 (6.9)	p<0.0001
	Yes	356 (80.4)	87 (19.6)	
Exposure to smoking scenes in movies	Not at all	1411 (94.9)	75 (5.1)	p<0.0001
	1 to 5	3433 (91.7)	311 (8.3)	
	More than 6	494 (85.5)	84 (14.5)	
Exposure to smoking scenes in videos	Not at all	1373 (95.4)	66 (4.6)	p<0.0001
	1 to 5	3486 (91.6)	318 (8.4)	
	More than 6	487 (84.4)	90 (15.6)	
Closest friends' smoking status	None of them	3182 (97.9)	68 (2.1)	p<0.0001
	Some of them	1936 (88.4)	253 (11.6)	
	Most of them	183 (62.2)	111 (37.8)	
	All of them	56 (56.0)	44 (44.0)	
Have intention of smoking from friends cigarette offer	No	5182 (96.9)	165 (3.1)	p<0.0001
	Yes	192 (38.3)	309 (61.7)	

to improve the model's explanation level. The significance level of statistic analysis was 0.05.

## RESULTS

The total number of female participants was 3006 (53.5%) and the number of male participants was 2609 (46.5%). The 1st grade students were the largest proportion of participants with 2106 (36.7%) followed by the 3rd grade with 1864 (32.5%), and the 2nd grade with 1764 (30.8%). The number of participants according to the place where they live are as follows: Seoul with 1901 (32.0%), Metropolitan cities with 2156

(36.3%), and Provinces with 1883 (31.7%).

The number of male participants who show their intentions of smoking within 5 years was slightly higher with 218 (8.4%), compared to female students with 215 (7.2%) (p=0.077). The higher the grade, the number of students who have future smoking intention increased: 122 (5.8%) in the 1st grade, 149 (8.5%) in the 2nd grade and 149 (10.1%) in the 3rd grade (p<0.0001). A total number of 164 (8.7%) among the students living in Seoul, 150 (7.1%) among the students living in Metropolitan cities and 167 (8.9%) among the students living in Provinces show positive response to future smoking (p=0.062)(Table 1).

The study analyzed the association between the ten

**Table 3.** The result of the first multiple logistic regression after adjusting gender, grade and region - The determinants of future smoking intentions among Korean adolescents aged 13-15

Factor	Category	OR	95% CI
Gender	Male	1.00	
	Female	0.68	0.51-0.91
Grade*	1st	1.00	
	2nd	1.11	0.77-1.61
	3rd	1.02	0.71-1.47
Region†	Seoul	1.00	
	Metropolitan Cities	0.97	0.69-1.38
	Cities and Provinces	0.97	0.68-1.38
Current smoking status	No	1.00	
	Yes	1.64	1.09-2.47
Ever tried smoking	No	1.00	
	Yes	2.92	2.09-4.09
Monthly allowance	Less than \$10	1.00	
	\$11 - \$30	1.23	0.84-1.81
	More than \$30	1.43	0.98-2.12
Parents' smoking status	None	1.00	
	Either and More	1.85	1.36-2.51
Have learnt about the effects of smoking	No	1.00	
	Yes	0.87	0.65-1.16
Ownership of something with a cigarette brand logo	No	1.00	
	Yes	1.44	0.93-2.21
Exposure to smoking scenes in movies	Not at all	1.00	
	1 to 5	1.03	0.69-1.55
	More than 6	0.86	0.47-1.57
Exposure to smoking scenes in videos	Not at all	1.00	
	1 to 5	1.04	0.68-1.57
	More than 6	1.28	0.69-2.35
Closest friends' smoking status	None of them	1.00	
	Some of them	2.19	1.53-3.14
	Most of them	3.33	1.95-5.68
	All of them	2.43	1.10-5.41
Have intention of smoking from friends' cigarette offer	No	1.00	
	Yes	21.21	15.29-29.41

Adjusted for gender, grade and region.

OR: odds ratio, CI: confidence interval.

\* Middle school grades, † The Cities and Provinces where the participants live.

independent factors related to adolescent smoking and intentions of future smoking. As shown in table 2, all of the selected variables were independently associated with future smoking intention and all the results were highly statistically significant ( $p < 0.05$ ) (Table 2).

The study conducted a multivariate logistic regression to identify the determinants of future smoking intentions among participants after adjusting the socio-demographic characteristics, gender, grade and region where the participants live (Table 3). The fit of the logistic regression was good, with a Hosmer-Lemeshow statistic of 11.50 and  $p$  value of 0.175.

The status of smoking both currently and in the past has a casual link with future smoking intentions. The students who are current smokers (a current smoker defined in this study is someone who has smoked at least one cigarette stick in 30 days) are on average 1.64 times (95% CI=1.09-2.47) more likely to be smokers within 5 years, compared to those who do not currently smoke.

Those students who have past smoking experience are on average 2.92 times (95% CI=2.09-4.09) more likely to possess future smoking intentions than the students who do not have any smoking experience. The determinants of smoking status of friends and parents have powerful association with adolescents' smoking intentions. Compared to the students who do not have any friends that smoke, those who have some friends smoking are on average 2.19 times (95% CI=1.53-3.14) more likely, those who have most friends smoking are 3.33 times (95% CI=1.95-5.68) more likely, and those who have all their friends smoking are 2.43 times (95% CI=1.10-5.41) more likely to be smokers within 5 years. The students who have intention of smoking from friends' cigarette offer are on average 21.21 times (95% CI= 15.29 - 29.41) more likely to be smokers in the future, compared to students who do not have intention of smoking from friends' cigarette offer. In addition, those who have either and both parents who smoke are

**Table 4.** The result of the second multiple logistic regression after adjusting gender, grade and region - The determinants of future smoking intention among the non-smoking Korean adolescents aged 13-15

Factor	Category	OR	95% CI
Gender	Male	1.00	
	Female	0.70	0.50-0.98
Grade*	1st	1.00	
	2nd	1.16	0.75-1.79
	3rd	1.21	0.79-1.87
Region <sup>†</sup>	Seoul	1.00	
	Metropolitan Cities	1.30	0.85-1.97
	Cities and Provinces	1.29	0.84-1.97
Ever tried smoking	No	1.00	
	Yes	2.73	1.92-3.88
Monthly allowance	Less than \$10	1.00	
	\$11 - \$30	1.25	0.81-1.95
	More than \$30	1.41	0.89-2.24
Parents' smoking status	None	1.00	
	Either and More	1.85	1.28-2.65
Have learnt about the effects of smoking	No	1.00	
	Yes	0.83	0.59-1.17
Ownership of something with a cigarette brand logo	No	1.00	
	Yes	1.73	1.03-2.91
Exposure to smoking scenes in movies	Not at all	1.00	
	1 to 5	0.99	0.62-1.56
	More than 6	0.63	0.29-1.35
Exposure to smoking scenes in videos	Not at all	1.00	
	1 to 5	1.26	0.77-2.06
	More than 6	1.35	0.64-2.86
Closest friends' smoking status	None of them	1.00	
	Some of them	1.90	1.30-2.80
	Most of them	5.27	2.85-9.74
	All of them	2.42	0.66-8.82
Have intention of smoking from friends' cigarette offer	No	1.00	
	Yes	31.47	21.50-46.05

Adjusted for gender, grade and region.

OR: odds ratio, CI: confidence interval.

\* Middle school grades, <sup>†</sup> The Cities and Provinces where the participants live.

on average 1.85 times (95% CI=1.36-2.51) more likely to smoke within 5 years, compared to those students whose parents do not smoke. There was, however, no significant statistic association in the rest of the determinants selected - ownership of a product with a cigarette brand logo, total sum of monthly allowance, learning the harmful effects of smoking, and exposure to smoking scenes in movies and videos - with intentions of future smoking, after adjusting the socio-demographic characteristics.

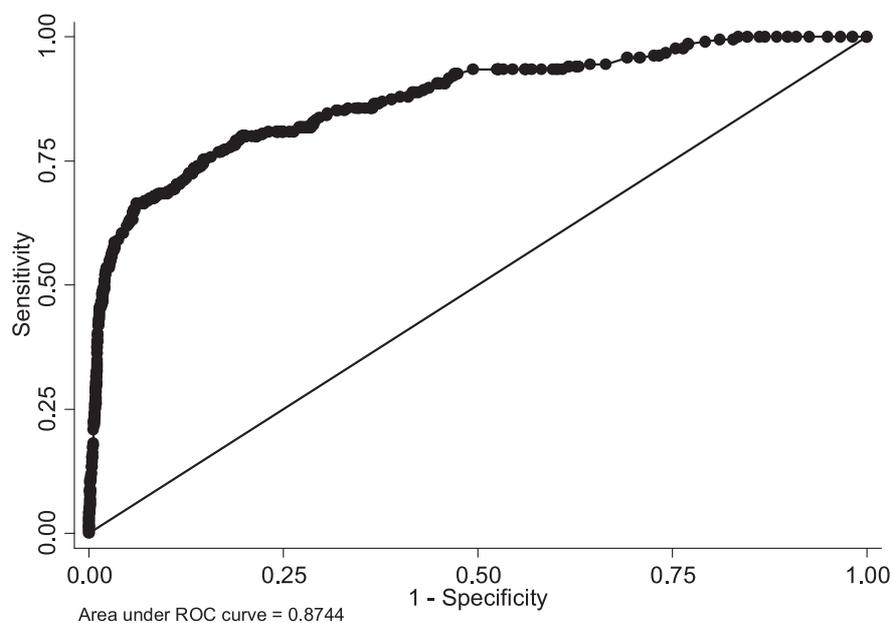
More than half of the current smoking participants show their intentions of future smoking within 5 years, and the result of Chi-square test was statistically significant ( $p < 0.0001$ ). This might be their intention of continuing to smoke rather than intentions of future smoking, hence, the study carried out another multivariate logistic regression except for the current smoking participants. It was expected that the result of the second logistic regression would have a more powerful explanation level for the prediction model. The

result of regression is shown in table 4 (Table 4).

Through an analysis of the second multiple logistic regression, the study developed a prediction model of the Korean adolescents' future smoking intentions, which can be applied to identify the high risk group exposed to future smoking. The developed model consists of five determinants 'have experience of smoking', 'have parents who smoke', 'have something with a cigarette brand logo', 'have closest friends who currently smoke', and 'have intention of smoking from friends' cigarette offer'. The area under ROC curve was 0.8744 (95% CI=0.85 - 0.90) for current non-smokers (Figure 1).

## DISSCUSSION

The aim of this study was to identify the determinants of the Korean adolescents' future smoking intentions and to develop a prediction model for the high risk group



**Figure 1.** The Korean prediction model for future smoking intention among non-smoking adolescents aged 13 - 15.

ROC: receiver operation characteristic.

exposed to future smoking. For the purpose of the study, the Korea GYTS 2004 was analyzed as a primary data. The sample size of the survey was almost 6000 which were relatively big and the sample was selected through a two-stage cluster sampling. Therefore, the sample may well be a representation of the Korean adolescents in general and the prediction model developed by the study can be applied to classify the high risk group exposed to future smoking among the non-smoking Korean middle school students. In addition, unlike previous analyses in regard to adolescent smoking [13-20], this study is unique in that it focuses on intentions of future smoking rather than the difference between current smokers and non-smokers.

The relevant determinants found by the study of future smoking intention among Korean adolescents aged 13 to 15 were 'have experience of smoking', 'have parents who smoke', 'have something with a cigarette brand logo', 'have closest friends who currently smoke', and 'have intention of smoking from friends' cigarette offer'. This result is partly similar to that of Markham's study examining the future smoking intentions of UK adolescents. Markham et al. indicate that influential people such as parents and friends of adolescents and their self-efficacy regarding smoking are directly related with future smoking intentions among UK adolescents [10].

The number of middle school students who have intentions of smoking within 5 years is much higher with

8.4% of male and 7.2% of female than the current smoking rate with 4.6% of male and 2.6% of female in 2007 [2]. This outcome shows possible increase of the smoking rate among adolescents aged 13 to 15. Hence, it is recommended that more powerful and effective health policies and interventions should be implemented to prevent adolescents from smoking. Additionally, the high risk group exposed to future smoking needs more attention.

A fuller understanding of how socio-demographic characteristics, such as gender and grade, influence on intentions of smoking is important when designing a smoking intervention program. The study found that there was no difference in intentions of future smoking between male and female adolescents ( $p=0.077$ ). This finding indicates that tobacco control intervention for adolescents should evenly focus on male and female adolescents. Meanwhile, there are differences in intentions of future smoking among grades 1, 2, 3 ( $p<0.0001$ ), thus smoking intervention programs for adolescents must be designed and implemented differently according to the grade of targeted groups.

Previous studies analyze the influence of adolescents' exposure to smoking scenes in movies on their cigarette use [21-23]. This has been an important health issue because the cigarette manufacturers have often utilized movies as a core marketing tool targeting the youth. However, so far only a few studies have been progressed to investigate the association between tobacco use in

movie scenes and adolescents' intentions of future smoking. Sargent reports that smoking scenes in movies increase intentions of future smoking among the European adolescents [22]. Thompson and Gunther also inform that adolescents who are not restricted from R-rated movies (adult movies) are on average 3.3 times more likely to smoke in the future compared to adolescents who are totally restricted [24]. Yet, unlike the result of previous studies, there was no association between exposure to smoking scenes in movies and future smoking intentions among Korean adolescents.

There was a relationship between ownership of a product with a cigarette brand logo and intentions of future smoking (95% CI=1.03-2.91). This is a similar outcome with previous analyses [25-27]. This finding offers a lesson that the government has to restrict the marketing strategy using non-cigarette products by tobacco companies.

Park reports that the school-based smoking prevention programs have not influenced on smoking behavior among Korean adolescents as much as anticipated [9], whereas Kim et al. demonstrates that the knowledge of the health hazard of smoking impacts on adolescent smoking [18]. However, in this study there was no casual link between the school-based programs and future smoking intentions among middle school students (95% CI=0.59-1.17). This finding indicates that a program to target the high risk group exposed to future smoking needs to be designed rather than a program targeting all the students which cannot be sufficient to protect adolescents from future smoking.

The determinants, smoking status of parents (OR, 1.85; 95% CI=1.28-2.65) and close friends (OR 5.27; 95% CI=2.85-9.74), have relatively high association with intentions of future smoking among Korean middle school students. These variables are well known as powerful determinants associated with both adolescent smoking and future smoking intentions [13,14,18,28-30]. These outcomes offer a lesson that a school-based program alone is not enough. Tobacco control interventions should be provided simultaneously by families, communities and schools.

Meanwhile, there was the strongest relationship between intentions of smoking when friends offer a cigarette and intentions of future smoking (OR, 31.47; 95% CI=21.50-46.05). A possible explanation for this is that adolescents are at their beginning of social-activities in which they are vulnerable to environmental influences so they are susceptible to peer pressure and influence. In other words, any offers or recommendations from close friends are significant determinants to adolescents

whenever they make decisions [16].

Previous analyses describe that adolescents who have more pocket money have higher smoking prevalence than those who have less money [16,18,31]. Due to this outcome, the policy of increasing the cigarette price is widely applied in order to reduce the smoking prevalence of both adolescents and adults. However, this study found that there was no association between monthly allowance (the ability to purchase cigarettes) and future smoking intention among Korean adolescents.

## Limitations of the Study

There are some important limitations in the study. First, sample selection bias is possible, however, the GYTS is designed to employ a two-stage cluster sampling in order to produce a nationally representative sample. Hence, the amount of bias, if any, can be minimal. Second, although a previous study which analyzed determinants of future smoking intentions used the Attitudes-Social influences-Efficacy model in order to measure intentions of future smoking [10], this study only used a simple questionnaire to obtain the same information. In addition, there is a lack of important determinants, such as self-efficacy which is believed to determine intentions of future smoking among adolescents, in the selected independent factors due to the solely use of the GYTS. These are important limitations which must be considered when interpreting the results of this study. Third, given that the GYTS is a cross-sectional and a self-administrative survey, the interpretation of some determinants such as exposure to smoking scenes in movies, current smoking status and past smoking experience is restricted.

## Practical Use of the Prediction Model

In order to evaluate the explanation level of the developed prediction model, the study applied ROC assessment. The cut off value calculated by ROC analysis is generally determined when the sum of sensitivity (true positive rate) and specificity (true negative rate) is the highest and as the specificity goes up, the sensitivity relatively comes down. In this study the area under the ROC was 0.88744, thus the prediction rate of the model was high. In terms of specificity and sensitivity in the ROC curve, it does not seem like it will be a problem that the specificity is lower than the sensitivity.

As mentioned above, cigarette smoking among

Korean adolescents aged 13 to 15 has been an important public health issue, so school-based interventions have been widely carried out with various methods. However, due to the limitations of the existing programs, the result of school-based interventions have not met the expectation [9]. Therefore, this study suggests that a school-based smoking prevention program should be designed to focus on the high risk group exposed to future smoking rather than targeting all the students. The process of the suggested smoking prevention program is as follows. First, carry out the simple survey designed by the prediction model in order to identify the students of the high risk group exposed to future smoking. Second, develop suitable programs according to each targeted groups of high and low risk students of future smoking. And then finally implement the developed programs with more attention on the high risk group. By following this procedure, it is anticipated that the limitations of the current school-based programs can be eliminated. Furthermore, there is a need for the prediction model from this cross-sectional study to be applied to prospective studies in order to analyze the efficiency of the model itself.

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## CONFLICT OF INTEREST

The authors have no conflict of interest to declare on this study.

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