

Factors Related to Increasing Trends in Cigarette Smoking of Adolescent Males in Rural Areas of Korea

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Objectives: Cigarette smoking prevalence among adolescent males in rural areas of Korea has increased in recent years. The aim of this study was to explore the factors related to increasing trends in cigarette smoking among adolescent males living in rural areas.

Methods: The raw data from the Korea Youth Risk Behavior Web-based Survey from 2006 to 2009 were used. Data were analyzed by using the method of complex survey data analysis considering complex sampling design. Multiple logistic regression models were used to explore the factors affecting cigarette smoking. We evaluated the linear time trends in the prevalence of factors that were related to current smoking status and the linear time trends in cigarette smoking in groups stratified by the exposure to each factor using logistic regression models. Finally, we examined the contributions of the factors to the time trends in cigarette smoking by adjusting for each of those factors in the baseline regression models and changes in the adjusted odds ratio by survey year.

Results: A statistically significant increasing trend in smoking was observed after adjusting for the factors affecting cigarette smoking. Significant factors related to cigarette use were perceived stress, experience with depression, current alcohol drinking, exposure to secondhand smoke, and academic performance. The factor related to increasing trends in cigarette smoking was academic performance.

Conclusions: Stress about academic performance is an important factor affecting the increase in cigarette smoking among adolescent males in a rural area of Korea.

Key words: Smoking, Trends, Adolescent, Korea Youth Risk Behavior Web-based Survey

INTRODUCTION

It has been determined that genomic damage by chemical and carcinogenic substances included in cigarettes is more severe in adolescents because their body's cells are immature and in the process of growing [1]. Adolescents who start smok-

ing at a young age risk experiencing DNA damage, and thus the risk of lung cancer in their adulthood is increased [2]. In addition, smoking has negative effects on all aspects of adolescents' lives given its relationship to juvenile delinquency including alcohol and drug use and violence [3]. Moreover, an early first smoking experience increases the possibility of continuing to smoke as an adult [4]. Programs to prevent smoking and to stop smoking for adolescents should be a priority in national adolescent health policy.

Since 1980, the adolescent population in the rural areas of Korea has been declining rapidly. The number of adolescents and young adults aged 15 to 29 in rural areas shrunk from 3 754 863 in 1980, to 1 786 061 in 2000, and to 875 187 in 2004. This result is mainly related to deteriorating rural conditions. Only 23% of rural adolescents were found to be satisfied

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with rural life, and they recognized that the culture, career opportunities, public health, and education levels in rural areas were lower than those of urban areas [5]. Because of poor rural conditions and rural adolescents' negative attitudes such as a sense of defeat and deprivation, the rate of misbehavior of rural adolescents was reported to be higher than that of urban adolescents [6], as was the smoking rate. The smoking rate in high school students of rural areas was greater than that of urban areas [7]. In a study on factors related to adolescent smoking analyzed by rural area, small town, and metropolitan city, the total smoking experience rate and the smoking experience rate before 13 years of age in rural areas were significantly higher than those of urban areas [8].

In particular, recent adolescent smoking trends as well as cross-sectional smoking rates in rural areas have deteriorated relative to those of urban areas. In a recent study on the trends in smoking indicators in urban and rural adolescents, it was reported that the current smoking rate, frequent smoking rate, and heavy smoking rate have all increased in rural areas [9]. As the gap in smoking-related behaviors between rural and urban adolescents is increasing, an adolescent smoking prevention and tobacco control program should prioritize rural areas. Furthermore, the exact assessment of the smoking problem and the establishment of effective policies for rural adolescents should take into consideration the factors related to increasing trends in cigarette smoking. However, most previous studies on adolescent smoking were cross-sectional studies investigating only factors affecting whether they smoke or not, and few studies have addressed the factors related to trends in cigarette smoking.

Therefore, the purpose of this study is to investigate factors related to increasing cigarette smoking trend in adolescent males residing in rural areas where smoking has shown increasing trend in the most recent four years, and thus to provide the basic data on smoking-related factors for development of effective interventions in rural adolescent males.

METHODS

Subjects and Data Analysis

This study is a secondary data analysis using the raw data from the Korea Youth Risk Behavior Web-based Survey (KYRBWS). The KYRBWS is an annual survey that has been performed since 2005 in middle and high school student to identify adolescents' health behaviors over the previous year. The

steps in the sampling process were stratification, sample allocation, and sampling itself. In the population stratification, the KYRBWS grouped cities (si), towns (gu), and districts (gun) within 16 provinces of Korea into metropolitan cities, small towns, and rural areas. Using stratification variables by region group considering geographical accessibility, the number of schools, population, living conditions, smoking rate, and alcohol drinking, and type of school (middle, academic high, and vocational high schools), 135 strata were produced. In the sample allocation, proportional allocation was applied to correspond with the population and sample distribution ratios by stratification variables. Two-stage cluster sampling was used, which means schools were the first extraction unit and classes were the second extraction unit [10].

Considering the change in the survey methods and content, four years of KYRBWS data, from 2006 to 2009 excluding 2005, were used in this study. Among these data, the analysis was performed on data from adolescent males living in rural areas from a sample extraction frame of the KYRBWS in which the population was stratified by metropolitan cities, small towns, and rural areas.

Methods

The dependent variable was the current cigarette smoking status. The definition of 'a current smoker' was a person who had smoked one or more days in the most recent 30 days. For independent variables which explained the dependent variable, among factors showed to be related to adolescent smoking based on a literature review [11-18], analyzable variables were selected for analysis considering the change of survey methods and content in the KYRBWS items from 2006 to 2009. The current alcohol drinking rate was defined as the proportion of people who had one drink or more drinks in the past 30 days. The perceived stress rate was defined as the proportion of people who reported very high or high stress. The rate of experience with depression was defined as the proportion of people who experienced sadness and despair strong enough to prevent performing the activities of daily living for two weeks out of the most recent 12 months. The rate of exposure to secondhand smoking was defined as the proportion of people who were close to an active smoker for one day or more in the most recent seven days.

Data Analysis

The KYRBWS had a complex sampling design, and thus a

survey analysis technique taking into account stratification, clustering, and weighting of data was used. A chi-square test was performed to examine the distribution of independent variables and the significance of their differences in the smoking and non-smoking groups. To investigate smoking-related factors, a multiple logistic regression analysis was used. Two hypotheses were established to verify factors related to increasing trends in cigarette smoking. The first hypothesis was that the smoking rate would have increased by the increased number of adolescents who were exposed to smoking-related factors. The second hypothesis was that the smoking rate in the group exposed to risk factors would have increased more sharply than that of the group without such exposure; thus, risk factors would affect the smoking rate than before. In other words, more frequent exposure to risk factors and a more intense relationship with the risk factors of smoking are expected to be related to the increasing trend in the cigarette smoking rate. To verify the first hypothesis, a trend analysis of the exposure rate to factors affecting the smoking status in rural adolescent males was performed. For the second hypothesis, the trend analysis for smoking rates was performed in groups stratified by the exposure to each factor. The trend analysis was performed by a logistic regression analysis. For the last step, we examined the contributions of factors that affected current smoking status to the time trend of smoking by adjusting for each factor that affected current smoking status in the baseline regression model with adjustment for age and type of school and examining changes in the adjusted odds ratio and the time trend in smoking. SAS version 9.2 (SAS Institute, Cary, NC, USA) was used for all of the analyses. A value of $p < 0.05$ was considered statistically significant. A value of p between 0.05 and 0.1 was considered a borderline significance level.

RESULTS

The current smoking rate in rural male adolescents increased to 21.6% in 2009 from 15.9% in 2006. The smoking rate of high school students was higher than that of middle school students, and the rate of vocational high school students was greater than that of academic high school students. High smoking rates were found in groups in the upper year in school, with strong feelings of unhappiness, high stress, and high depression, high alcohol intake, and high exposure to secondhand smoking. The group who responded that their academic per-

formance was below average had a higher smoking rate than the others. The group who responded that their economic status was below average also had a higher smoking rate than those who reported otherwise. There were significant differences between the smoking and non-smoking groups in all of the variables (Table 1).

Based on a multiple logistic regression analysis examining factors affecting current smoking, it was found that type of school (middle, academic high, and vocational high schools), perceived stress, experience with depression, current alcohol drinking, exposure to secondhand smoking, and academic performance affected the current smoking status in rural ado-

Table 1. General characteristics of study subjects by smoking status

		Weighted frequency (%)		p-value ¹
		Smoker	Nonsmoker	
Survey year	2006	25 988 (15.9)	137 751 (84.1)	0.03
	2007	26 294 (19.3)	109 833 (80.7)	
	2008	24 395 (21.6)	88 396 (78.4)	
	2009	24 628 (21.6)	89 235 (78.4)	
School type	Middle	26 731 (9.9)	242 299 (90.1)	<0.001
	Academic high	34 833 (24.0)	110 018 (76.0)	
	Vocational high	39 741 (35.3)	72 899 (64.7)	
Year in school	Middle 1st	5479 (6.1)	84 205 (93.9)	<0.001
	Middle 2nd	8533 (9.4)	81 896 (90.6)	
	Middle 3rd	12 719 (14.3)	76 199 (85.7)	
	High 1st	23 460 (26.1)	66 526 (73.9)	
	High 2nd	26 601 (30.6)	60 249 (69.4)	
	High 3rd	24 513 (30.4)	56 142 (69.6)	
Feeling of happiness	Happy or fair	84 437 (18.5)	372 908 (81.5)	<0.001
	Unhappy	16 867 (24.4)	52 308 (75.6)	
Perceived stress	A little or none	51 756 (16.3)	266 114 (83.7)	<0.001
	Much or very much	49 548 (23.8)	158 386 (76.2)	
Experience with depression	No	53 003 (15.7)	285 451 (84.3)	<0.001
	Yes	48 301 (25.7)	139 765 (74.3)	
Current alcohol drinking	No	25 427 (7.0)	338 124 (93.0)	<0.001
	Yes	75 877 (46.6)	87 092 (53.4)	
Exposure to secondhand smoke	No	37 716 (13.4)	244 117 (86.6)	<0.001
	Yes	63 588 (26.0)	181 099 (74.0)	
Academic performance	Average or above	44 291 (13.7)	278 893 (86.3)	<0.001
	Below average	57 014 (28.0)	146 323 (72.0)	
Economic status of family	Average or above	66 037 (17.3)	315 592 (82.7)	<0.001
	Below average	35 268 (24.3)	109 624 (75.7)	

¹p-value by chi-square test.

lescent males. Even after adjusting for other variables such as type of school, year in school, subjective feeling of happiness, perceived stress, experience with depression, current alcohol drinking, exposure to secondhand smoking, academic performance, and family economic condition, the year of the data collection had significant effect on the current smoking status. The odds ratio was 1.200 (Table 2).

To examine whether the increasing trend of smoking was caused by the increased number of adolescents who were exposed to the factors affecting the current smoking status the

Table 2. Factors affecting cigarette smoking

	β^1	p-value	Odds ratio (95% CI)	
Survey year ²	0.182	<0.001	1.200 (1.120, 1.285)	
School type	Middle		1.0 (reference)	
	Academic high	0.333	0.02	1.395 (1.037, 1.877)
	Vocational high	0.885	<0.001	2.423 (1.814, 3.236)
Year in school ²	0.066	0.07	1.068 (0.995, 1.146)	
Feeling of happiness	Happy or fair		1.0 (reference)	
	Unhappy	-0.046	0.58	0.955 (0.810, 1.126)
Perceived stress	No		1.0 (reference)	
	Yes	0.198	<0.001	1.218 (1.098, 1.352)
Experience with depression	No		1.0 (reference)	
	Yes	0.261	<0.001	1.298 (1.158, 1.455)
Current alcohol drinking	No		1.0 (reference)	
	Yes	2.146	<0.001	8.552 (7.563, 9.670)
Exposure to secondhand smoke	No		1.0 (reference)	
	Yes	0.594	<0.001	1.811 (1.621, 2.024)
Academic performance	Average or above		1.0 (reference)	
	Below average	0.751	<0.001	2.119 (1.871, 2.399)
Economic status of family	Average or above		1.0 (reference)	
	Below average	-0.006	0.92	0.994 (0.883, 1.119)

CI, confidence interval.

¹Logistic regression coefficients.

²Numeric variable.

annual prevalence rates for risk factors affecting the current smoking status and the trends in the adjustment for type of school and year in school were verified. It was found that the perceived stress rate decreased by a level of borderline significance, to 36.9% in 2009 from 40.0% in 2006. The rate of the experience with depression significantly decreased to 32.1% in 2009 from 36.7% in 2006. In addition, the current alcohol drinking rate decreased to 28.8% in 2009 from 31.2% in 2006, but the change was not significant. The rate of exposure to secondhand smoking increased significantly to 44.7% in 2009 from 41.4% in 2006, and the proportion of perceived academic performance below average significantly increased to 41.5% in 2009 from 35.3% in 2006 (Table 3).

Analyzing the trends in the current smoking rate by the exposure to smoking-related factors, the current smoking rate of the group with perceived stress was significantly increased to 25.1% in 2009 from 20.8% in 2006. Moreover, even in the group without perceived stress, the rate had increased to 19.6% in 2009 from 13.2% in 2006. The regression coefficient in the group with perceived stress was 0.106 and in the group without perceived stress was 0.156, which meant that the rate was more sharply increased in the group without perceived stress. Smoking rates were significantly increased in both groups with depression experience and without depression experience. Reviewing the regression coefficient, the smoking rate increased more in the group who did not experience depression. In addition, the smoking rates were significantly increased in both groups with and without current alcohol drinking, although the group with no current drinking showed a steeper increase. For the secondhand smoking, while the current smoking rate was significantly increased in the group who had not been exposed to secondhand smoking, there was almost no difference in the group with the exposure to secondhand smoking. Smoking rates were significantly increased in both the group who responded that their academic performance

Table 3. Prevalence of and trend in risk factors affecting cigarette smoking

	2006	2007	2008	2009	β^1 (p for trend ²)
Perceived stress	40.0 (37.3, 42.6)	40.6 (38.6, 42.7)	40.3 (38.2, 42.4)	36.9 (34.9, 38.9)	-0.036 (0.10)
Experience with depression	36.7 (35.2, 38.1)	38.2 (36.1, 40.3)	35.0 (33.3, 36.8)	32.1 (30.2, 34.1)	-0.069 (<0.001)
Current alcohol drinking	31.2 (28.0, 34.4)	32.8 (29.8, 35.9)	30.7 (27.1, 34.2)	28.8 (24.6, 33.0)	-0.040 (0.32)
Exposure to secondhand smoke	41.4 (39.1, 43.6)	50.6 (48.9, 52.4)	50.6 (48.3, 52.9)	44.7 (42.4, 47.0)	0.054 (0.02)
Academic performance (below average)	35.3 (33.8, 36.7)	38.1 (36.4, 39.8)	41.2 (39.1, 43.2)	41.5 (39.2, 43.8)	0.094 (<0.001)

Values are presented as prevalence (95% confidence interval).

¹Logistic regression coefficients.

²Adjusted for school type and year in school.

Table 4. Prevalence of and trend in cigarette smoking by factors that influence adolescent smoking

		2006	2007	2008	2009	β^1 (p for trend ²)
School type	Middle	8.8 (7.5, 10.0)	10.5 (8.4, 12.5)	11.1 (9.3, 12.8)	9.9 (8.0, 11.8)	0.050 (0.23)
	Academic high	17.0 (12.3, 21.7)	23.5 (18.0, 29.0)	28.9 (22.7, 35.1)	29.9 (24.2, 35.7)	0.248 (<0.001)
	Vocational high	32.6 (29.1, 36.0)	34.9 (29.2, 40.5)	37.2 (30.1, 44.4)	37.5 (28.2, 46.7)	0.076 (0.25)
Perceived stress	No	13.2 (10.7, 15.7)	15.5 (12.5, 18.5)	18.2 (14.7, 21.7)	19.6 (15.5, 23.7)	0.156 (<0.001)
	Yes	20.8 (16.8, 23.4)	24.9 (21.6, 28.2)	26.7 (22.9, 30.5)	25.1 (20.7, 29.4)	0.106 (0.03)
Experience with depression	No	12.1 (9.9, 14.3)	15.7 (12.7, 18.6)	17.9 (14.8, 21.0)	18.3 (14.6, 22.0)	0.162 (<0.001)
	Yes	22.4 (18.8, 26.0)	25.2 (21.6, 28.8)	28.5 (23.6, 33.4)	28.7 (23.6, 33.7)	0.111 (0.04)
Current alcohol drinking	No	4.8 (3.5, 6.0)	6.7 (5.3, 8.1)	8.4 (6.7, 10.1)	9.1 (7.3, 10.9)	0.227 (<0.001)
	Yes	40.5 (37.0, 43.9)	45.2 (40.9, 49.5)	51.6 (46.7, 56.4)	52.6 (45.8, 59.4)	0.163 (<0.001)
Exposure to secondhand smoke	No	7.7 (5.9, 9.5)	14.6 (12.2, 17.0)	16.3 (13.0, 19.5)	18.2 (14.4, 22.0)	0.281 (<0.001)
	Yes	27.5 (24.4, 30.6)	23.9 (20.1, 27.7)	26.9 (22.5, 31.2)	25.9 (21.2, 30.5)	0.001 (0.80)
Academic performance	Average or above	11.5 (9.2, 13.7)	14.8 (12.0, 17.5)	15.4 (12.6, 18.3)	14.2 (11.0, 17.5)	0.093 (0.03)
	Below average	24.0 (20.3, 27.6)	26.7 (22.9, 30.6)	30.5 (25.7, 35.3)	32.1 (27.0, 37.1)	0.126 (0.007)

Values are presented as prevalence (95% confidence interval).

¹Logistic regression coefficients.

²Adjusted for school type and year in school.

Table 5. Changes in adjusted odds ratios and trends in cigarette smoking after adjustment for factors that influence adolescent smoking

	2006	2007	2008	2009	β^1 (p for trend)
Baseline (adjust for school and grade)	1.00	1.263 (1.019, 1.566)	1.481 (1.197, 1.833)	1.449 (1.147, 1.832)	0.129 (<0.001)
Baseline + current alcohol drinking	1.00	1.271 (1.044, 1.548)	1.642 (1.351, 1.995)	1.706 (1.380, 2.110)	0.188 (<0.001)
Baseline + exposure to secondhand smoke	1.00	1.195 (0.968, 1.475)	1.410 (1.142, 1.740)	1.455 (1.156, 1.830)	0.130 (<0.001)
Baseline + perceived stress	1.00	1.258 (1.009, 1.568)	1.479 (1.190, 1.839)	1.470 (1.157, 1.869)	0.134 (<0.001)
Baseline + experience with depression	1.00	1.255 (1.014, 1.554)	1.504 (1.213, 1.865)	1.496 (1.180, 1.895)	0.140 (<0.001)
Baseline + academic performance	1.00	1.242 (0.998, 1.545)	1.417 (1.142, 1.757)	1.373 (1.083, 1.740)	0.110 (0.003)

Values are presented as odds ratio (95% confidence interval).

¹Logistic regression coefficients.

was below average and those reporting an average level or above. The smoking rate increased more in the group who responded with below average academic performance (Table 4).

Reviewing the change in the odds ratios when adjusting for each risk factor and the trends in the current smoking rate in the basic regression model with the adjustment for type of school and year in school, odds ratios, and the trends of the current smoking rate were not reduced even after adjusting for variables such as the current drinking status, secondhand smoking, perceived stress, and experience with depression. Meanwhile, with the adjustment for academic performance, the odds ratio, and the increasing trend of the current smoking rate decreased (Table 5).

DISCUSSION

Unlike previous studies, this study analyzed long-period

data to investigate factors affecting trends. Until now, most studies have been cross-sectional studies to explore factors affecting outcomes. Although studies on trends have been recently performed using accumulated data including the Korean National Health and Nutrition Examination Survey and the KYRBWS, studies on the factors affecting trends are rare. In a Korean study on factors affecting the trend in decreased blood pressure and the reduced number of hypertension patients among children [19], the authors examined the contributions of obesity, health behaviors, nutritional factors, and psychological and sociodemographic factors that affected hypertension to the time trends in hypertension prevalences by adjusting for each of those covariates in the baseline regression models and examining changes in the adjusted odds ratios and trends by survey year. In this study, we examined the contributions of perceived stress, depression experience, current drinking status, exposure to secondhand smoking, and aca-

ademic performance that affected current smoking status to increasing trends of smoking by adjusting for each of those covariates in the baseline regression models and examining changes in the adjusted odds ratios and time trends in the cigarette smoking rate (Table 5). Factors related to the increasing smoking rates were investigated by the following two hypotheses: more frequent exposure to risk factors would cause an increasing smoking rate (Table 3), and a stronger intensity in the relationship with smoking would cause an increasing smoking rate (Table 4). In this study, the results of analyses of these two hypotheses were the same as those of method used in previous study. Thus, the logical validity of this study was supported.

Based on these results, it can be concluded that other factors would also be related to the increasing smoking rate in rural male adolescents beyond the factors of type of school, year in school, subjective happiness, depression experience, current drinking status, exposure to secondhand smoking, academic performance, and family economic status. With the multiple logistic regression analysis, even after the adjustment for every factor, smoking differed in a statistically significant manner by survey year, and thus the risk rate for smoking increased by about 20% every year. In this study, only analyzable variables that were not changed in the KYRBWS from 2006 to 2009 were included in the model among factors related to adolescent smoking; thus, other factors may influence the increasing smoking rate in rural adolescent males. Other factors which were not considered in this study such as smoking peers, attitude and knowledge about smoking, family co-residence, amicable relationship with family, parents' education level, and satisfaction with the school and the family are considered to have an influence on the increasing trends in the cigarette smoking rate.

In this study, academic performance was related with the increasing trend in the cigarette smoking rate. In the most recent four years, the proportion of those who perceived their academic performance to be below average was significantly increased, and the current smoking rate was more rapidly increased in the group who reported below average academic performance. From this result, it was concluded that academic performance was related to the increasing trend in the cigarette smoking rate. Among the factors related to current smoking status identified in the multiple logistic regression analysis, the perceived stress rate, rate of experience with depression, and current alcohol drinking rate showed a decreasing trend,

and the current smoking rates in the groups without exposure to stress, depression, or a risk of drinking were more sharply increased than with exposure to the risk factor. Thus, it was concluded that these variables were not related to the increasing trends in the current smoking rates. The rate of exposure to secondhand smoking was significantly increased; however, the current smoking rate in the group with exposure to secondhand smoking was almost the same, while the current smoking rate in the group without exposure to secondhand smoking had sharply increased to 18.2% in 2009 from 7.7% in 2006. Thus, it was concluded that the rate of the exposure to secondhand smoking was not related to the increasing trend in the cigarette smoking rate either. These results can be confirmed based on the change in the adjusted odds ratios for each factor and the trend in the smoking rate. In the basic regression model adjusted for type of school and year in school, rates for current drinking, depression experience, perceived stress, exposure to secondhand smoking were somewhat higher after adjustment. However, after the adjustment for academic performance, the increasing trends in cigarette smoking rate was reduced; thus, it was concluded that academic performance was related to the smoking rate in rural adolescent males.

Reviewing the trend in the current smoking rate by type of school (middle, academic high, and vocational high schools), the rate had significantly increased in only academic high school students. The current smoking rate of the total academic high school students had slightly increased to 13.3% in 2009 from 12.8% in 2006 [10]; however, the current smoking rate of the rural adolescent males in academic high schools had increased to 29.9% in 2009 from 17.0% in 2006. This increasing rate among rural adolescent males in academic high schools is worth noting. The goal of students in vocational high schools is to enter the working world; on the other hand, considering that the purpose of academic high school students is to enter colleges, their comparative disadvantage relative to urban students could be related to the increasing smoking rate in academic high school students of rural areas. Because of the exodus of the younger generation from rural areas, the adolescent population of rural areas has been rapidly decreasing since 1980. This situation had caused rural community to deteriorate in terms of education, culture, and public health [5]. This is the reason that students with high academic performance or better economic conditions move out of rural areas, which in turn results in the low academic performance level of

rural students compared to that of urban students. In this study, the proportion of rural students responding that their academic performance was below average increased significantly. Rural students would be able to recognize the gap in the academic performance between rural and urban areas by the open test results of the Scholastic Aptitude Test and the National Assessment of Educational Achievement. According to the study of Kim et al. [6], rural students considered low academic performance to be the most serious of their school life issues, and the strongest difference between rural and urban high school students was their sense of the possibility of realistically attaining their desired occupations, which was 19.4% and 34.6%, respectively. Thus, it was concluded that lower academic performance in rural students compared to urban students caused low self-esteem, negative sense of self, and pressure and stress about academic performance. It can be concluded that stress and an inferiority complex due to academic performance in rural adolescents, especially in academic high school students, is related to their increasing smoking rate. To solve this problem, improvement in the educational conditions and development of differentiated school programs for rural areas are necessary, and broad improvement of rural communities where adolescents' dreams and expectations are difficult to realize are ultimately needed.

The limitations of this study are as follows: The first limitation is that variables not included in the KYRBWS were not investigated among factors related to adolescent smoking because this was a secondary data analysis study. The second limitation is that a study period of four years is insufficient for the exact investigation of trend-related factors. Accurate analyses of trend-related factors will become possible when an ongoing survey with a stable methodology and content from year to year is performed. The last limitation is that this study could not identify a direct cause and effect relationship because it was a cross-sectional study. Variables related to the increasing trend in the cigarette smoking rate in rural adolescent males were estimated by reviewing the trends in the smoking-related risk factors; however, an accurate cause and effect relationship could not be identified due to the limitation of the cross-sectional KYRBWS data. In spite of these limitations, this study is meaningful because it is the only study to investigate factors related to the trends in adolescent smoking in Korea. Furthermore, this study is expected to be of use as basic data on how health behaviors deteriorate due to low income, educational conditions, culture, and public health conditions in rural ado-

lescents.

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CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

REFERENCES

1. Pavanello S, Clonfero E. Biomarkers of genotoxic risk and metabolic polymorphism. *Med Lav* 2000;91(5):431-469 (Italian).
2. Wiencke JK, Kelsey KT. Teen smoking, field cancerization, and a "critical period" hypothesis for lung cancer susceptibility. *Environ Health Perspect* 2002;110(6):555-558.
3. Camenga DR, Klein JD, Roy J. The changing risk profile of the American adolescent smoker: implications for prevention programs and tobacco interventions. *J Adolesc Health* 2006;39(1):120.e1-120.e10.
4. Khuder SA, Dayal HH, Mutgi AB. Age at smoking onset and its effect on smoking cessation. *Addict Behav* 1999;24(5):673-677.
5. Kim KJ, Oh HS, Kim JM, Choi KH. Welfare policy assessment and program development for rural youth. Seoul: National Youth Policy Institute; 2005, p. 29, 49-52 (Korean).
6. Kim SS, Kim KJ, Jeon KS. A study on rural adolescent issues and improvement of 21st century. Seoul: National Youth Policy Institute; 2000, p. 23-27, 98-100 (Korean).
7. Yoon YJ, Kim YH, Kim DH, Shin DH, Kwon CH. Smoking rate and knowledge of smoking hazards for male high school students in urban and rural areas. *J Korean Acad Fam Med* 1996;17(10):877-883 (Korean).
8. Park SW. Health behaviors among adolescents in the rural area in Korea. *J Agric Med Community Health* 2009;34(2):202-213 (Korean).
9. Hong NS, Kim KY, Park SW, Kim JY, Bae J, Lee WK, et al. Trends in cigarette use behaviors among adolescents by region in Korea. *J Prev Med Public Health* 2011;44(4):176-184.
10. Korea Centers for Disease Control and Prevention. Report on the Korea Youth Risk Behavior Web-based Survey 2009. Cheongwon: Korea Centers for Disease Control and Prevention; 2010.

- p. 1-6, 18 (Korean).
11. Park SH. Factors affecting cigarette use and an increase in smoking frequency among adolescents in South Korea. *J Korean Acad Child Health Nurs* 2007;13(3):318-328 (Korean).
 12. Kim H, Kim EK, Choi ES, Kim YJ, Lee HJ, Kim JJ, et al. The determinants of adolescent smoking by gender and type of school in Korea. *J Prev Med Public Health* 2006;39(5):379-388 (Korean).
 13. Byeon J, Cho YT. School smoking rate as a social factor affecting the adolescent smoking in Korea: multilevel analysis. *Korean J Health Promot* 2010;27(4):7-16 (Korean).
 14. Lee CY, Storey MJ, Cho WJ, Bae SH, Lee KH, Ham OK, et al. A study of adolescent smoking related factors in the Seoul area. *J Korean Community Nurs* 2004;15(1):95-101 (Korean).
 15. Choi WH, Je MS, Lee SS. Factors related to smoking behavior among high school students. *J Korean Acad Public Health Nurs* 2010;24(2):226-236 (Korean).
 16. Yu BK, Oh YJ, Lee JC, Lee KH, Min JH, Park SH. A study of adolescent smoking and drinking in Korea. *Korean J Pediatr* 2009; 52(4):422-428 (Korean).
 17. Lee SW, Park SW. Smoking behaviors and associated factors among elementary school students in a rural area. *J Korean Soc Matern Child Health* 2005;9(1):73-84 (Korean).
 18. Lee K. A study on smoking status of adolescent and its related factors in a rural area [dissertation]. DaeJeon: Konyang University; 2005 (Korean).
 19. Khang YH, Lynch JW. Exploring determinants of secular decreases in childhood blood pressure and hypertension. *Circulation* 2011;124(4):397-405.