Impact of nearby smoking on adolescent smoking behavior in Korea

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Abstract

Although youth smoking is a very significant topic, research on youth smoking is limited. More specifically, youth smoking studies are limited to certain schools and regions. In this study, we investigated the association between number of nearby smokers and adolescent smoking behavior.

This study used South Korea's representative Youth Risk Behavior Web-based Survey from 2014 to 2016. A total 198,814 adolescents were included in the analysis. Survey logistic regression models were used to examine the association. We also analyzed subgroup models and various combinations of nearby smokers to explain adolescent smoking behavior.

Adjusting for variables associated with smoking behavior, multivariate survey logistic regressions revealed that adolescents with more nearby smokers had a greater risk for smoking (1 person: odds ratio [OR], 5.090; 2 persons: OR, 8.405; 3 persons or more: OR, 12.039, all statistically significant). Combinations of nearby smokers also show that the risk of smoking increases as the number of people increases. In particular, smoking increased significantly when with friends.

The study found that, as the number of surrounding cigarette smokers increases, the smoking rate in teenagers increases, and there is a tendency to vary according to social status. We recommend that educators and policy makers use a variety of approaches considering social environmental factors in smoking prevention programs and smoking cessation education for adolescents.

Abbreviations: KYRBS = Korea's representative Youth Risk Behavior Web-based Survey; WHO = World Health Organization.

Keywords: adolescent smoking behavior, nearby smoking, public health, smoking and tobacco

1. Introduction

Adolescence is a very important transition period to adulthood. Adolescents are emotionally unstable due to the rapid development of their bodies and the excessive pressures from society and education.[1] Physical, emotional, and socially transitioning adolescents respond very sensitively to their surroundings, because their self-identity and self-consciousness are not fully established.[2]

Tobacco has been the most preventable cause of mortality and morbidity for decades.[3–7] Although the risk of smoking is well known, adolescents continue to smoke. Approximately, 90% of adult smokers begun smoking before age of 18, each day in the United States, additional 2100 adolescents became daily smokers, and more than 3200 adolescents aged 18 years or younger became first smoker.[8,9]

In 2016, the adolescent smoking rate in Korea was 6.3%, with more male students (9.6%) smoking than female students (2.7%). For 11 years, the smoking rate decreased by approximately 5% among boys and by 6% among girls.[10] However, the current mean age of onset of smoking is 12.7 years, which is similar to that of the previous 11 years, suggesting that the youth smoking problem remains.[11] In particular, smoking in adolescence increases the duration of smoking, as well as daily smoking consumption and nicotine dependence.[12] The WHO suggests that smoking is one of the most dangerous behaviors that threaten human health.[13] Smokers who start smoking in adolescence continue to smoke for approximately 16 to 20 years, and up to 50% will become heavy smokers.[14]

Studies on factors influencing adolescent smoking behavior were dominated by individual factors; however, some previous studies also reported on social environmental factors.[15] Individual factors include expectations for smoking, sex, age, stress, allowance, and positive perception.[16–22] Smoking is believed to be harmful to health, but individuals are more likely to smoke if they have a positive attitude toward smoking, such as believing in positive psychological stability achieved through smoking.[16] Social environmental factors include school performance, stress, economic status, and friendships.[18,19,21,23] There is a tendency to smoke as a solution to escape from the stress of competitive and entrance-oriented competitive education programs.[24,25] The greater is the number of friends who smoke or suggest smoking, the greater is the influence on youth smoking.[26] In addition to these research factors, it is noteworthy

that family members are included as social environmental factors influencing youth smoking. Parents are the most meaningful environmental factor for their children, as children learn by mimicking their parents' behaviors, including smoking attitudes and behaviors.[21]

Although youth smoking is very significant topic, research in the area is limited. In particular, youth smoking studies are limited to certain schools and regions. Since adolescent smoking is a precursor to predicting adolescent health and juvenile delinquency,[27] research on youth smoking needs to be expanded in various ways. In this study, we aimed to examine how number of nearby smokers influences adolescent smoking behavior using nationally representative online survey data of youth health behaviors in South Korea.

2. Methods

2.1. Data and study population

We used data from Korea's representative Youth Risk Behavior Web-based Survey (KYRBS) database from 2014 and 2016. The study consisted of 205,631 students (from grades 7 to 12, aged 12–18 years) who were sampled randomly. Sampling for the KYRBS consisted of stratified randomization. The population consisted of stratified parameters, such as region and grade level. As for strata of variables, the number of sampled schools was distributed based on city, county, size of the city, and school type using a proportional allocation method to match population and sample compositions.[28] In total, 198,814 students were used for the final analysis, excluding those who did not know the answers to or did not respond to the variables related to the study. The KYRBS was reviewed and approved by the institutional review board of the Korea Centers for Disease Control and Prevention (2014-06EXP-02-P-A).

2.2. Variables

The variables used in this study were those surveyed for 3 years at KYRBS, which were survey year, demographic characteristics, socioeconomic characteristics, health behaviors, and adolescent smoking status. The demographic characteristics examined were sex, age, and region. The socioeconomic characteristics were type of school, income level, academic performance, type of residence, part time job, and allowance in 1 week. The health behaviors examined were lifetime drinking, stress, and subjective health status.

Current smokers are classified as those who have smoked on more than 1 of the last 30 days, as is presented in the KYRBS guidelines. Nearby smoking was categorized as the presence of smoking among friends, fathers, mothers, siblings, grandparents, and others in the vicinity of the adolescents. KYRBS collection of these items began in 2014.

Among the variables related to demographic characteristics, sex was classified into men and women. Age was a continuous variable from 12 to 18 years.

Among the variables related to the socioeconomic characteristics, type of school was divided into "middle school," "high school," and "vocational high school" in the question "What is the economic status of the household?", economic status was defined as "upper" for individuals who answered "upper or upper-intermediate"; "intermediate" as "middle"; and "low-intermediate or low" as "low." For the question "During the last 12 months, what is your academic record?," academic performance was defined as "upper" if the individual answered "upper

or upper-intermediate"; "intermediate" as "middle"; and "low-intermediate or low" as "low." Residence type was classified into "family"; "relation"; "board, live apart from family, dormitory"; and "nursery facilities." Students were classified as having or not having a part-time job. Finally, 1 week of allowance was categorized into $50 units.

Among the variables related to health behavior, lifetime drinking was divided into "yes" and "no" through the item "Have you ever drunk more than one drink?" In the question "How often do you feel stress?," stress was defined as "a lot" for individuals who answered "lot or a lot"; "little" as "little"; and "a little or never" as "a little." In the question "What do you think about your health condition?," subjective health status was defined as "healthy" for individuals who answered "very healthy or healthy"; "normal" as "normal"; and "unhealthy or not very health" as "unhealthy."

2.3. Statistical analysis

This study was conducted using nationwide sample surveys and KYRBS results with stratified cluster extraction and weighting. First, we examined descriptive statistics on smoking behavior, demographic characteristics, socioeconomic characteristics, and health behavior of the participants. The present study examined the relationship between current smoking and surrounding smokers and performed cross-sectional analyses between demographic characteristics, socioeconomic characteristics, and health behavior to confirm differences among groups. Next, multivariate survey-logistic regression analysis was performed to determine the relationship between number of nearby smokers and adolescent smoking behavior, adjusted for demographic and socioeconomic characteristics, and health behaviors. In addition, subgroup analysis and combination group analysis were performed for each variable, and statistical significance was set at $P < .05$. The proposed results produced reliable statistics that can represent the population by reflecting the weights. Percentages and confidence intervals were weighted by stratified exposures. All statistical analyses were performed using SAS statistical software, version 9.4 (SAS Institute Inc, Cary, NC).

3. Results

Of the 198,814 individuals included in our analyses, 14,268 were current smokers (7.2%). Smokers are more likely to have 3 or more nearby smokers (none: 0.6%, 1 person: 5.5%, 2 persons: 13.8%, 3 persons or more: 22.3%). More current smokers were men than women (men: 11.1%, women: 3.1%). Vocational high school students (20.3%) and those living in a rural area (8.7%), having low academic performance (11.5%), or receiving a weekly allowance of more than $100 (21.7%) had a higher frequency of smoking than the comparative group (Table 1).

To compare current smokers by number of nearby smokers, survey logistic regression analyses were performed after adjusting for sex, age, type of school, region, lifetime drinking, income, academic performance, type of residence, part time job, stress, health, and weekly and annual allowance. Subjects with more nearby smokers were at greater risk for adolescent smoking (1 person: OR, 5.090; $\rho < 0.001$, 2 persons: OR, 8.405; $\rho < 0.001$, 3 persons or more: OR, 12.039; $\rho < 0.001$, none: ref) (Table 2).

To investigate the detailed reasons for nearby smokers and adolescent smoking behavior, we conducted subgroup analysis. Results showed that the risk of smoking increased as the number of nearby smokers increased in all subgroups. The risk for

Table 1

General characteristics of study sample by smoking status.

Variables	Total	Nonsmoker		Smoker		P
		N	%	N	%	
Total	198,814	184,546	92.8	14,268	7.2	
Number of nearby smokers						
None	54,021	53,684	99.4	337	0.6	<.0001
1	85,408	80,689	94.5	4719	5.5	
2	47,459	40,905	86.2	6554	13.8	
3 or more	11,926	9268	77.7	2658	22.3	
Sex						
Male	101,513	90,258	88.9	11,255	11.1	<.0001
Female	97,301	94,288	96.9	3013	3.1	
Age,[*] y	14.96	14.88	1.7	16.00	1.4	
Region						
Rural area	15,865	14,487	91.3	1378	8.7	<.0001
Metropolitan	87,659	81,710	93.2	5949	6.8	
Urban area	95,290	88,349	92.7	6941	7.3	
Type of school						
High school	81,238	73,864	90.9	7374	9.1	<.0001
Middle school	99,457	96,245	96.8	3212	3.2	
Vocational high school	18,119	14,437	79.7	3682	20.3	
Economic status						
Upper	70,354	66,056	93.9	4298	6.1	<.0001
Middle	95,135	88,875	93.4	6260	6.6	
Low	33,325	29,615	88.9	3710	11.1	
Academic performance						
Upper	75,215	72,022	95.8	3193	4.3	<.0001
Middle	56,009	52,709	94.1	3300	5.9	
Low	67,590	59,815	88.5	7775	11.5	
Type of residence						
Family	190,041	176,699	93.0	13,342	7.0	<.0001
Relation	1545	1273	82.4	272	17.6	
Board, live apart from family, dormitory	6502	6001	92.3	501	7.7	
Nursery facilities	726	573	78.9	153	21.1	
Part time job						
No	173,525	166,293	95.8	7232	4.2	<.0001
Yes	25,289	18,253	72.2	7036	27.8	
Allowance in 1 week						
<50$	173,567	163,405	94.2	10,162	5.9	
50$–100$	18,202	15,622	85.8	2580	14.1	<.0001
≥100$	7045	5519	78.3	1526	21.7	
Lifetime drinking						
No	119,338	118,034	98.9	1304	1.1	<.0001
Yes	79,476	66,512	83.7	12,964	16.3	
Stress						
A lot	72,417	65,990	91.1	6427	8.9	
A little	86,115	80,616	93.6	5499	6.4	<.0001
Little	40,282	37,940	94.2	2342	5.8	
Subjective health status						
Healthy	143,178	133,408	93.2	9770	6.8	
Normal	43,691	40,382	92.4	3309	7.6	<.0001
Unhealthy	11,945	10,756	90.1	1189	10.0	
Year						
2014	70,192	64,274	91.6	5918	8.4	
2015	65,450	60,747	92.8	4703	7.2	<.0001
2016	63,172	59,525	94.2	3647	5.8	

[*] Avg/sd.

smoking changed more among women than men as the number of nearby smokers increased [women: 1 person: OR, 6.375, 95% confidence interval (CI): 4.837–8.404; 2 persons: OR, 14.146, 95% CI: 10.706–18.693; 3 persons or more: OR, 22.800, 95% CI: 17.176–30.266; none: ref; VS male=1 person: OR, 4.605, 95% CI: 3.992–5.312; 2 persons: OR, 6.996, 95% CI: 6.075–8.057; 3 persons or more: OR, 9.253, 95% CI: 7.929–10.798; none: ref]. In addition, the risk for smoking varies with metropolitan living, low academic performance, low allowance, and being in middle school (Fig. 1).

In addition, changes in the risk of smoking were identified according to the composition of the nearby smoker characteristics. These results also show that the risk of smoking increases as the number of nearby smokers increases. In particular, smoking

Table 2

Results of multivariate survey-logistic regression: risk factors for smoking.

Variables	Odds ratio	95% Wald confidence limit		P
Number of nearby smokers				
None	1.000			
1	5.090	4.489	5.772	<.001
2	8.405	7.416	9.526	<.001
3 or more	12.039	10.525	13.77	<.001
Sex				
Female	1.000			
Male	4.136	3.880	4.409	<.001
Age[*]	1.131	1.101	1.162	<.001
Region				
Urban area	1.000			
Rural area	0.936	0.824	1.064	.313
Metropolitan	1.034	0.965	1.108	.338
Type of school				
Middle school	1.000			
High school	0.951	0.855	1.058	.359
Vocational high school	1.506	1.316	1.725	<.001
Economic status				
Upper	1.000			
Middle	0.969	0.916	1.025	.272
Top	1.257	1.18	1.340	<.001
Academic performance				
Upper	1.000			
Middle	1.316	1.236	1.402	<.001
Low	2.168	2.050	2.293	<.001
Type of residence				
Family	1.000			
Relation	1.832	1.509	2.222	<.001
Board, live apart from family, dormitory	0.783	0.679	0.903	<.001
Nursery facilities	2.684	1.985	3.628	<.001
Part time job				
No	1.000			
Yes	3.528	3.346	3.720	<.001
Allowance in 1 week				
<50$	1.000			
50$–100$	1.544	1.453	1.641	<.001
≥100$	1.961	1.806	2.128	<.001
Lifetime drinking				
No	1.000			
Yes	7.953	7.436	8.506	<.001
Stress				
Little	1.000			
A little	1.059	0.992	1.131	.087
A lot	1.401	1.315	1.492	<.001
Subjective health status				
Healthy	1.000			
Normal	1.062	1.008	1.120	.025
Unhealthy	1.084	0.996	1.180	.062
Year[†]	0.825	0.793	0.859	<.001

[*] Avg/sd.

[†] Trend test.

increased significantly in a group including friends (friends: OR, 8.662, 95% CI: 7.566–9.917; friends + brothers and sisters: OR, 17.170, 95% CI: 14.264–20.667; friends + others: OR, 9.290, 95% CI: 7.857–10.985; friends + parents: OR, 9.470, 95% CI: 8.321–10.778; friends + parents + brothers and sisters: OR, 17.915, 95% CI: 15.175–21.150; friends + brothers and sisters + others: OR, 10.689, 95% CI: 6.236–18.321; friends + parents + others: OR, 8.508, 95% CI: 7.154–10.119; friends + parents + brothers and sisters + others: OR, 18.159, 95% CI: 13.480–24.463); the risk of smoking decreased with a group of only parents (parents: OR, 0.795, 95% CI: 0.654–0.966) (Fig. 2).

4. Discussion

When smoking starts during adolescence, the total smoking period and smoking amount increase, more harmful substances of tobacco accumulate in the body, and nicotine dependence increases, making smoking cessation difficult.[29] The greater is one's use of cigarettes at a young age, the higher is the risk of nicotine poisoning, and the greater is the likelihood of becoming a heavy smoker and experiencing premature death.[30] In addition, it has been reported that the lower is the age at which one starts smoking, the more difficult it is to quit smoking, which has a negative impact on health and quality of life.[31] As a result, the

Figure 1. Results of subgroup analyses of number of nearby smokers on adolescent smoking rate. All adjusted by sex, age, region, type of school, economic status, academic performance, type of residence, part-time job, allowance in 1 week, lifetime drinking, stress, subjective health status, and year. *Statistically significant.

Korean government has implemented various regular education programs.[32] In addition, they began designating youth facilities as areas that are completely nonsmoking in 2011 and are implementing environmental regulations, such as expanding nonsmoking areas to restaurants and public computer rooms by 2015.[33] Despite this persistent effort, students are still easily able to obtain tobacco and are exposed to secondhand smoke,[11] indicating that social environmental factors are not being adequately developed to prevent smoking in adolescents.
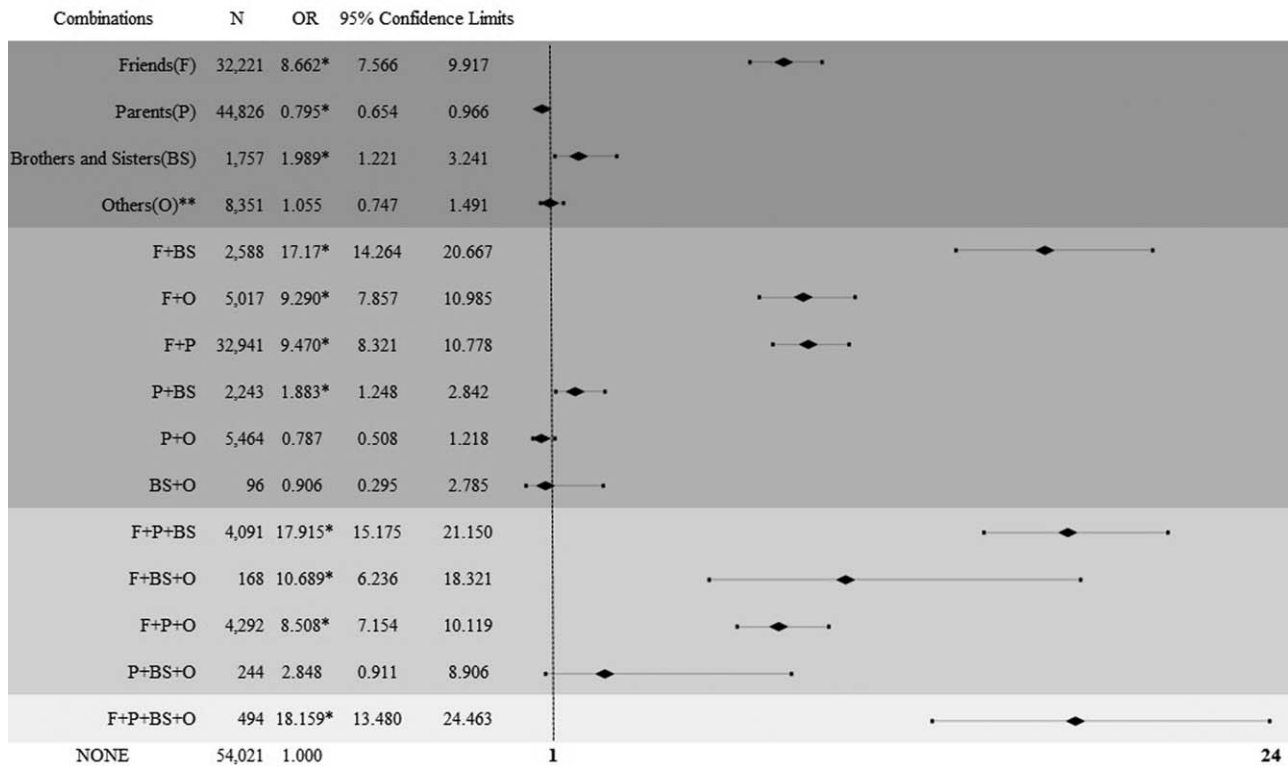
Combinations	N	OR	95% Confidence Limits	
Friends(F)	32,221	8.662*	7.566	9.917
Parents(P)	44,826	0.795*	0.654	0.966
Brothers and Sisters(BS)	1,757	1.989*	1.221	3.241
Others(O)**	8,351	1.055	0.747	1.491
F+BS	2,588	17.17*	14.264	20.667
F+O	5,017	9.290*	7.857	10.985
F+P	32,941	9.470*	8.321	10.778
P+BS	2,243	1.883*	1.248	2.842
P+O	5,464	0.787	0.508	1.218
BS+O	96	0.906	0.295	2.785
F+P+BS	4,091	17.915*	15.175	21.150
F+BS+O	168	10.689*	6.236	18.321
F+P+O	4,292	8.508*	7.154	10.119
P+BS+O	244	2.848	0.911	8.906
F+P+BS+O	494	18.159*	13.480	24.463
NONE	54,021	1.000		

Figure 2. Odds ratios for adolescent smoking status according to the combination of multiple nearby smokers. All adjusted by sex, age, region, type of school, economic status, academic performance, type of residence, part-time job, allowance in 1 week, lifetime drinking, stress, subjective health status, and year. *Statistically significant disparity was shown. **Others=grandparents or other family.

We found evidence that nearby smoking and youth smoking were significantly related to one another after adjusting various factors, and the greater is the number of nearby smokers, the higher is the adolescent smoking rate. Regarding individual factors, the results of this study did not vary with sex, age, stress, or amount of pocket money from previous researches.[17–23] In addition, this study also confirmed previous researches that the social environmental factors were significantly associated with family, friends, siblings, and so on.[18,19,21] However, this study analyzed various units and presented the results. More specifically, girls showed a greater change in their smoking behaviors in response to nearby smoking than did boys because girls tend to be more sensitive to social factors.[34] In addition, there were differences in area, grade, pocket money, and school type, which are highly related to the socioeconomic environment.

In addition, this study is meaningful because it is the first study to divide the complex relationship of the adolescents' nearby smokers by various combination types. Overall, the greater was the number of nearby smokers, the more complicated combinations are, and the greater is the increase in adolescent smoking, with the friend factor being the most influential. As in many previous studies,[19,21,26,35,36] adolescent smoking behavior was shown to be most affected by peers. In contrast, the risk for smoking was reduced when only the parents smoked, because parent attitudes toward smoking are more influential on adolescents than are parental smoking behaviors.[37]

In order to promote smoking prevention and smoking cessation in adolescents, it is necessary to consider not only individual efforts but also social environmental factors.[22,38] However, most adolescent smoking prevention programs have been conducted at the school level, and the scope of their activities

is limited to in and around the school, so students have little opportunity to participate in community-based programs that consider the social and environmental aspects of smoking.[39] Thus, interventions for adolescent smokers require subdivision of adolescent groups, because adolescents experience different influences from social environmental factors on smoking behaviors according to personal characteristics and would benefit from customized intervention.

Strengths of our study were that we minimized selection bias by using a representative sample of middle and high school students nationwide. In addition, our database comprised a sample size of 198,814 students. Finally, the KYRBS questionnaire used in our study demonstrated high consistency and reproducibility by showing a comparable trend of results annually. However, this study had some limitations. First, our study was a cross-sectional study; therefore, a temporal relationship cannot be established between adolescent smoking and number of nearby smokers. However, by applying various weights to the sample, we improved the representativeness and reliability, and smoking behavior was corrected through the significance test by year. Second, there are limitations to self-report questionnaire surveys. In Korea, knowing that women do not faithfully report their smoking in self-report questionnaires,[40] the smoking rate of female adolescents might be higher than that of the surveyed adults. Therefore, the collection of urine, saliva, and blood concentrations of cotinine would be useful biomarkers associated with smoking. Third, the definition of current smoking varies from study to study. In this study, the definition of smoking was defined as smoking for >1 of the last 30 days, per the KYRBS guidelines. Despite these limitations, this is a multidisciplinary study of the relationship between nearby smokers and adolescent

smoking behavior, which is valuable as a basic data for solving the problem of adolescent smoking.

5. Conclusions

Results of this study suggest that interventions in youth smoking behavior should consider not only individual factors, but also social environmental factors. In addition, it was confirmed that the effect varies according to individual social environment. We recommend that educators and policy makers take into account the social environmental factors surrounding youth when implementing smoking cessation education and programs in the future.

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Author contributions

DJK and SJK led the design and conception of the study, performed the data analysis, and wrote the manuscript. They contributed to the discussion and reviewed and edited the manuscript. The authors read and approved the final manuscript. SJK is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
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