



# Age at Smoking Initiation and Subsequent Smoking Among Korean Adolescent Smokers

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**Objectives:** The aim of this study was to investigate the relationship between age at cigarette smoking initiation and smoking level among adolescent current smokers.

**Methods:** In 2007, students from one or two classes of the 10th or 11th grade were randomly selected using the probability proportional to size sampling method. In total, 743 current smokers were included. Multiple logistic regression was used to determine the association between age at smoking initiation and smoking level as either frequent, daily, or heavy smokers.

**Results:** The adjusted odds ratios for each smoking level were significantly higher for younger ages of smoking initiation than those for older ages of initiation were ( $p$  for trend  $<0.001$ ). Compared with the students who started smoking in grades 10 to 11, the adjusted odds ratios for frequent, daily, and heavy smokers increased from 2.24 (95% confidence interval [CI], 1.30 to 3.87) to 3.90 (95% CI, 2.02 to 7.56), from 1.56 (95% CI, 0.92 to 2.62) to 3.17 (95% CI, 1.70 to 5.92), and from 2.56 (95% CI, 1.21 to 5.42) to 5.67 (95% CI, 2.61 to 12.30) with younger ages of smoking initiation.

**Conclusions:** Smoking frequency and amount were closely associated with age at smoking initiation. Therefore, smoking prevention programs should be initiated from the young adolescent period.

**Key words:** Adolescent, Age of onset, Smoking

## INTRODUCTION

Smoking habits formed in adolescence not only affect one's smoking behaviors in adulthood but are also related to other risky behaviors and negative health/social outcomes including alcohol and/or illicit drug use, academic problems, mental health problems, violence, and risky sexual behaviors [1,2]. Moreover, 80% of adults who had ever tried a cigarette report-

ed first smoking before the age of 18 [3]; therefore, adolescent smoking prevention should be a top priority to manage the public health problems related to cigarette smoking.

Previous studies suggested that smoking initiation in adolescence is closely associated with subsequent smoking behaviors including the amount and frequency of cigarette smoking, difficulties in smoking cessation, and nicotine dependency [4-15]. Many of these studies were conducted in adults and investigated the relationship between age at smoking initiation and their smoking behaviors in adulthood [4-9]. In addition, interventions to stop smoking were found to be more effective in adolescence than in adulthood because the long-term behavioral habituation in adults is difficult to change or improve.

Several studies with smoking interventions in adolescents have been performed, but some methodological limitations exist. First, important confounders closely related with smok-

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ing behaviors including interpersonal factors (friends, parents, and/or siblings who smoke), socioeconomic status (education and income level), deviant behaviors, and psychological well-being were not considered in most previous studies. For example, several studies considered only sex, age, and race/ethnicity as confounding factors [11-13,15]. Other studies included academic performance or the number of friends who smoked in addition to age, sex, and race/ethnicity [10,14]. Moreover, a convenient sampling method with no representative study population was another limitation of previous studies [10,11].

In addition, previous studies have revealed conflicting results. For example, the duration since smoking initiation was found to be negatively associated with daily smoking in adolescence, but without significance [11]. A recent prospective study suggested that smoking initiation later in adolescence may lead to subsequent heavier cigarette consumption and also criticized other studies for their methodological limitations including a cross-sectional design, recall bias for age at smoking initiation, and dichotomous or limited categorical variables that measured age at smoking initiation [10]. In addition, a vulnerable period may exist that increases an adolescent's risk of subsequent smoking behaviors [10].

Most previous studies were conducted in Western countries; only one study of this nature was conducted in Japan, but with similar limitations [15]. Therefore, this study was conducted to report the current smoking levels by age at smoking initiation among adolescents from a representative sample of urban-dwelling Koreans.

## METHODS

### Study Population

In 2007, all high school students in Daegu, South Korea were stratified by grade, sex, and region. Students from one or two classes of the 10th or 11th grade from each school were randomly selected from this list using the probability proportional to size sampling method. Among a sample of 4602 students from 30 high schools, 824 current smokers, who had smoked at least one cigarette during the previous month, answered a self-administered questionnaire. After excluding 81 (9.8%) students for missing data, a total of 743 students (526 males and 217 females) were included in this analysis. This study was approved by the institutional review board of Daegu Catholic University Medical Center.

### Variable Measurement

The age at smoking initiation was collected as the grade when respondents first tried a cigarette, even if they did not smoke the entire cigarette, as either grades 10 to 11, grade 9, grade 8, grade 7, or grades 1 to 6 or earlier. Based on smoking frequency and amount reported for the previous month, data on smoking levels were collected by means of three indicators: Frequent smokers were defined as students who had smoked 20 days or more. Daily smokers were defined as students who had smoked every day, and heavy smokers were defined as students who had smoked at least half a pack of cigarettes per day [3,16].

Potential confounders included sex, grade (10th or 11th), school type (general or vocational), perceived academic performance (high, middle, or low), perceived family economic level (high, middle, or low), frequency of alcohol drinking per month, perceived stress level (high, middle, or low), father's smoking history (never, former, current, or fatherless), sibling's cigarette use (no, yes, or no sibling), number of friends who smoke among their five closest friends, and ever purchasing cigarettes for their parents and someone else (never, previously, or currently).

### Statistical Analysis

Univariate logistic regression was used to estimate the relationship between each smoking level (frequent, daily, or heavy) and risk factors such as age at smoking initiation as well as other potential confounders. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated after adjusting for significant confounders from the univariate logistic regression to confirm the association between age at smoking initiation and smoking level. Statistical significance was defined as a *p*-value of less than 0.05, and all analyses were performed using IBM SPSS version 19.0 (IBM Corp., Armonk, NY, USA).

## RESULTS

Table 1 describes the frequency of the general characteristics for the total study population. Most participants reported trying their first cigarette in grade 9 (28.3%) followed by grade 8 (24.5%), grades 10 to 11 (17.6%), grades 1 to 6 or earlier (17.4%), and grade 7 (12.2%). Among the 764 current smokers, 524 (70.5%), 449 (60.4%), and 176 (23.7%) participants were frequent smokers, daily smokers, and heavy smokers, respectively.

Table 2 shows the results of the univariate logistic regression model that identified factors associated with each smoking level. The statistically significant factors associated with all the

**Table 1.** General characteristics of the study population

Characteristics	n (%)
Sociodemographic factors	
Sex	
Female	217 (29.2)
Male	526 (70.8)
Grade	
10th	338 (45.5)
11th	405 (54.5)
School type	
General	229 (30.8)
Vocational	514 (69.2)
Perceived academic performance	
High	127 (17.1)
Middle	297 (40.0)
Low	319 (42.9)
Perceived family economic level	
High	62 (8.4)
Middle	484 (65.1)
Low	197 (26.5)
Lifestyle and psychosocial factors	
Frequency of alcohol drinking (per month)	
Never	139 (18.7)
1-2	211 (28.4)
3-4	165 (22.2)
≥5	228 (30.7)
Perceived stress level	
Low	314 (42.3)
Middle	286 (38.5)
High	143 (19.2)
Smoking-related environmental factors	
Father's smoking history	
Never	99 (13.3)
Former	149 (20.1)
Current	455 (61.2)
Fatherless	40 (5.4)
Sibling's cigarette use	
No	416 (56.0)
Yes	165 (22.2)
No sibling	162 (21.8)
No. of friends who smoke among five closest friends	
≤2	115 (15.5)
3	95 (13.2)
4	114 (15.3)
5	416 (56.0)
Ever purchased cigarettes for their parents and someone else	
Never	357 (48.0)
Previously	320 (43.1)
Currently	66 (8.9)
Smoking behaviors	
Age at smoking initiation	
Grades 10-11	131 (17.6)
Grade 9	210 (28.3)
Grade 8	182 (24.5)
Grade 7	91 (12.2)
Grades 1-6 or before	129 (17.4)
Smoking levels	
Frequent smoker	524 (70.5)
Daily smoker	449 (60.4)
Heavy smoker	176 (23.7)

smoking levels were male gender, attending a vocational high school, frequently drinking alcohol, level of perceived stress, having many close friends who smoke, and initiating smoking at a younger age. The factors related with frequent smoking were having a father who had ever smoked, and higher grade. Factors related with daily smoking were higher grade and having ever purchased cigarettes for their parents and someone else. Last, factors related with heavy smoking were a low level of perceived academic performance, having siblings who smoke cigarettes, and having ever purchased cigarettes for their parents and someone else.

After adjustment for significant confounders in the univariate analysis, adjusted ORs for each level of smoking tended to increase with younger ages of smoking initiation ( $p$  for trend <0.001) when compared to students who started smoking in grades 10 to 11. Adjusted ORs for frequent smokers increased from 2.24 (95% CI, 1.30 to 3.87) to 3.90 (95% CI, 2.02 to 7.56) for those who started smoking from grade 9 to grades 1 to 6 or earlier. For daily smokers and heavy smokers, the adjusted ORs increased from 1.56 (95% CI, 0.92 to 2.62) to 3.17 (95% CI, 1.70 to 5.92) and from 2.56 (95% CI, 1.21 to 5.42) to 5.67 (95% CI, 2.61 to 12.30), respectively, for those who started smoking from grade 9 to grades 1 to 6 or earlier (Figure 1).

## DISCUSSION

This study found earlier ages at smoking initiation in adolescence to be strongly correlated with subsequent adolescent smoking levels including both smoking amount and frequency. These results are consistent with generally accepted concepts from nationally representative surveys from the United States [12]. Moreover, our study included important confounders such as interpersonal factors and other covariates, which were not considered in previous studies [17].

However, the results of this study conflicted with those of recent studies that found smoking initiation at a later age in adolescence to possibly lead to subsequent heavier cigarette consumption [10,11]. However, those studies used a convenience sampling method, thus their results cannot be generalized to all adolescents. In addition, very limited covariates were adjusted for in their statistical models, including sex, age, and the number of friends who smoke [10,11]. In our study, the most robust variable was the number of closest friends who currently smoked. Moreover, all confounding variables except for perceived family income level were significantly associated

**Table 2.** Factors associated with subsequent smoking levels in the univariate analysis

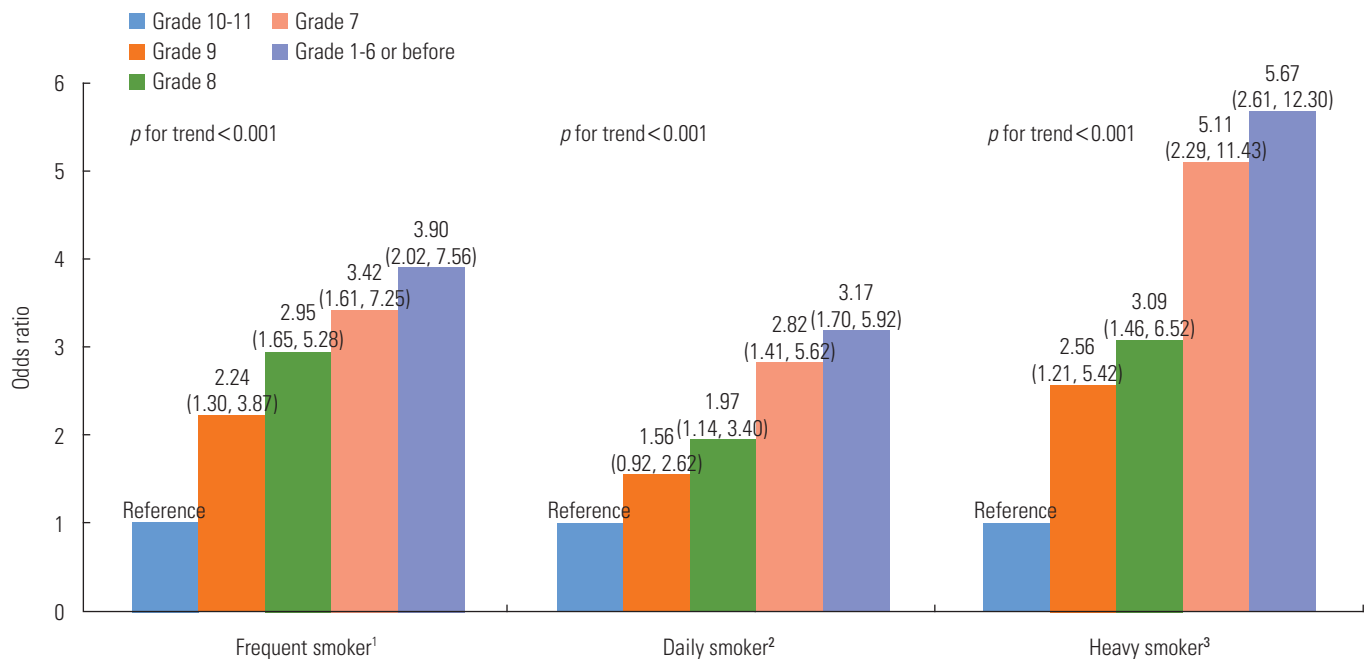
Characteristics	Frequent smoker	Daily smoker	Heavy smoker
<b>Smoking levels</b>			
Age at smoking initiation			
Grades 10-11	Reference	Reference	Reference
Grade 9	1.82 (1.16, 2.85)	1.43 (0.92, 2.20)	2.49 (1.23, 5.05)
Grade 8	2.65 (1.64, 4.29)	2.03 (1.29, 3.21)	3.58 (1.77, 7.24)
Grade 7	3.79 (2.02, 7.12)	3.30 (1.85, 5.90)	6.51 (3.08, 13.77)
Grades 1-6 or before	3.14 (1.83, 5.40)	2.94 (1.76, 4.92)	6.25 (3.06, 12.77)
<b>Sociodemographic factors</b>			
Sex			
Female	Reference	Reference	Reference
Male	2.18 (1.56, 3.05)	2.44 (1.76, 3.36)	1.90 (1.26, 2.87)
Grade			
10th	Reference	Reference	Reference
11th	1.42 (1.03, 1.94)	1.51 (1.13, 2.04)	1.13 (0.80, 1.59)
School type			
General	Reference	Reference	Reference
Vocational	1.72 (1.24, 2.40)	1.42 (1.04, 1.95)	1.70 (1.15, 2.52)
Perceived academic performance			
High	Reference	Reference	Reference
Middle	1.25 (0.80, 1.93)	1.13 (0.74, 1.72)	1.13 (0.67, 1.91)
Low	1.33 (0.86, 2.05)	1.28 (0.85, 1.95)	1.69 (1.02, 2.80)
Perceived family economic level			
High	Reference	Reference	Reference
Middle	1.22 (0.78, 1.90)	1.01 (0.59, 1.73)	0.64 (0.36, 1.13)
Low	1.34 (0.86, 2.09)	1.10 (0.61, 1.97)	0.59 (0.31, 1.10)
<b>Lifestyle and psychosocial factors</b>			
Frequency of alcohol drinking (per month)			
Never	Reference	Reference	Reference
1-2	2.10 (1.36, 3.26)	1.94 (1.26, 3.01)	2.34 (1.20, 4.54)
3-4	4.18 (2.52, 6.93)	4.33 (2.67, 7.02)	4.09 (2.11, 7.93)
≥5	4.25 (2.67, 6.77)	3.90 (2.50, 6.09)	4.56 (2.42, 8.61)
Perceived stress level			
Low	Reference	Reference	Reference
Middle	0.63 (0.44, 0.89)	0.63 (0.45, 0.87)	0.95 (0.64, 1.39)
High	0.95 (0.60, 1.48)	1.02 (0.67, 1.54)	1.60 (1.03, 2.49)
<b>Smoking-related environmental factors</b>			
Father's smoking history			
Never	Reference	Reference	Reference
Former	1.35 (0.79, 2.30)	1.05 (0.63, 1.75)	0.94 (0.50, 1.75)
Current	1.59 (1.01, 2.51)	1.44 (0.93, 2.30)	1.21 (0.72, 2.05)
Fatherless	3.53 (1.36, 9.20)	1.25 (0.59, 2.64)	1.79 (0.79, 4.06)
Sibling's cigarette use			
No	Reference	Reference	Reference
Yes	1.33 (0.88, 2.01)	1.41 (0.96, 2.06)	1.67 (1.11, 2.50)
No sibling	0.83 (0.56, 1.22)	0.88 (0.61, 1.27)	1.10 (0.71, 1.71)
No. of friends who smoke among five closest friends			
≤2	Reference	Reference	Reference
3	2.58 (1.47, 4.53)	2.28 (1.25, 4.16)	3.87 (1.21, 12.43)
4	6.40 (3.60, 11.38)	5.52 (3.09, 9.87)	8.61 (2.90, 25.54)
5	12.81 (7.93, 20.68)	11.53 (7.01, 18.95)	13.04 (4.71, 36.11)
Ever purchased cigarettes for their parents and someone else			
Never	Reference	Reference	Reference
Previously	1.34 (0.96, 1.86)	1.61 (1.18, 2.20)	1.69 (1.17, 2.44)
Currently	1.09 (0.62, 1.93)	1.55 (0.90, 2.69)	3.44 (1.97, 6.01)

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

with smoking amount and frequency in our analysis. Therefore, at least seven covariates were adjusted for in our model that was used to confirm the association between age at smoking

initiation and subsequent smoking behaviors.

Adolescents who start smoking at an early age smoked more frequently and were heavier smokers than those who started



**Figure 1.** Adjusted odds ratios (95% confidence intervals) of subsequent smoking levels according to age at smoking initiation. <sup>1</sup>Adjusted for sex, grade, school type, perceived stress level, frequency of alcohol drinking, father's smoking history, and number of friends who smoke among their five closest friends. <sup>2</sup>Adjusted for sex, grade, school type, perceived stress level, frequency of alcohol drinking, number of friends who smoke among their five closest friends, and ever purchasing cigarettes for their parents and someone else. <sup>3</sup>Adjusted for sex, school type, perceived academic performance, perceived stress level, frequency of alcohol drinking, sibling's cigarette use, number of friends who smoke among their five closest friends, and ever purchasing cigarettes for their parents and someone else.

at later age. As age at smoking initiation is inversely associated with nicotine dependence, people who start smoking earlier in life suffer more difficulty in quitting smoking than those who start later in life [3-5,7,9,18]. In addition, the success rate of smoking cessation in adolescents is low. In a nationally representative longitudinal study from the US, only 4% of current adolescent smokers are estimated to successfully quit smoking per year [19].

The evidence from this study and that of previous studies stress the importance of early interventions for smoking prevention, especially in adolescents. Thus, it is also meaningful to estimate the appropriate age to intervene for effective smoking prevention. In a randomized controlled trial, early school based interventions for smoking prevention starting from grade 1 (aged 5.3 to 7.7 years) significantly lowered the smoking rate in early adolescence by 1.5 to 1.8 times compared to students who did not receive the intervention [20]. Considering this positive effect after a smoking prevention program and our results that earlier smoking initiation is related with increased amount and frequency of cigarette smoking, smoking prevention programs should be implemented as early as possi-

ble. If early prevention programs are not possible, programs should be implemented at least before reaching the critical period when programs become less effective, and the critical period for implementation could be determined by considering the following.

First, smoking prevention programs are likely to be most effective if implemented at least before the majority of adolescents start smoking. According to a report by the US Surgeon General, more than 60% of people who have ever tried a cigarette or are currently regular smokers first smoked in grade 9 or earlier, and most current smokers first tried cigarettes in grades 8 to 9 [3]. Likewise, more than half of our study participants started smoking in grades 8 to 9. Therefore, implementing a smoking prevention program before grade 8 is recommended.

Second, it is necessary to consider the variation in smoking levels by age at smoking initiation. In our study, frequency of smoking among all three smoking levels increased gradually with age at smoking initiation. However, the odds of being a frequent, daily, or heavy smoker increased sharply in one point in time for each smoking level. For example, compared to those who started smoking in grades 10 to 11, the ORs of being a fre-



quent, daily, or heavy smoker among those who started smoking at grade 9 were 2.24 (95% CI, 1.30 to 3.87), 1.56 (95% CI, 0.92 to 2.62), and 2.56 (95% CI, 1.21 to 5.42), respectively. In addition, compared with those who started cigarette smoking at grade 8, the ORs of being a daily or heavy smoker among those who started cigarette smoking at grade 7 were 1.43 or 1.65, respectively, which is higher than that among frequent smokers. However, the odds of smoking among those who started in grade 6 or earlier compared with those who started in grade 7 ranged from 1.11 to 1.14 across all three smoking levels. Accordingly, these results suggest that if smoking initiation were prevented through grade 8 with the help of smoking prevention programs, the proportion of those who progress to become daily or heavy smokers would be effectively reduced. To this end, intervention programs should be implemented at least before grade 8.

Third, students in the transition period from elementary (grades 1 to 6) to middle school (grades 7 to 9) experience psychological distress, decreased academic achievement, and adjustment problems due to being exposed to new environments [21]. In addition, this period overlaps with the onset of puberty that can also cause emotional stress. As a result, students in this age range are at a higher risk of deviant behaviors including substance abuse than students in elementary school are. A previous study also suggested that if smoking prevention programs in all grades is impossible, programs should at least be introduced in the transition year from elementary to middle school [22]. For those reasons, smoking prevention programs should begin at least by late elementary school.

There are some limitations in our study. First, this cross-sectional study cannot determine whether a causal relationship between age at smoking initiation and subsequent smoking levels exists. Second, information on age at smoking initiation was obtained by retrospective recall, so recall bias may have influenced our results. Finally, the number of participants who started smoking before grade 6 was too small to allow for stratification into smaller subgroups by grade. Therefore, we could not identify a relationship between age at smoking initiation and subsequent smoking levels in these students. Despite these limitations, a major strength of this study is that it considered important covariates including interpersonal factors, socioeconomic status, deviant behaviors, and psychological well-being using a regionally representative sample of urban-dwelling Korean adolescents.

In conclusion, this study found that earlier smoking initiation

among adolescents increases the likelihood of becoming frequent, daily, and heavy smokers. Therefore, preventing or delaying cigarette smoking is important using appropriate smoking prevention programs. Based on the results of this study, we suggest that smoking prevention programs should begin at least by late elementary school.

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## CONFLICT OF INTEREST

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

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