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 habitation 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-
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
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 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                                     | 310 (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)  |
Table 2. Factors associated with subsequent smoking levels in the univariate analysis

| Characteristics                                      | Frequent smoker | Daily smoker | Heavy smoker |
|------------------------------------------------------|-----------------|--------------|--------------|
| **Smoking levels**                                   |                 |              |              |
| Age at smoking initiation                           |                 |              |              |
| Grades 10-11                                         | 1.82 (1.16, 2.85) | 1.43 (0.92, 2.20) | 2.49 (1.23, 5.05) |
| Grade 9                                              | 2.65 (1.64, 4.29) | 2.03 (1.29, 3.21) | 3.58 (1.77, 7.24) |
| Grade 8                                              | 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) |
| **Sociodemographic factors**                         |                 |              |              |
| Sex                                                  |                 |              |              |
| Female                                               | 2.18 (1.56, 3.05) | 2.44 (1.76, 3.36) | 1.90 (1.26, 2.87) |
| Male                                                 | 1.42 (1.03, 1.94) | 1.51 (1.13, 2.04) | 1.13 (0.80, 1.59) |
| Grade                                                |                 |              |              |
| 10th                                                 | Reference       | Reference    | Reference    |
| 11th                                                 | 1.25 (0.89, 1.73) | 1.13 (0.74, 1.72) | 1.13 (0.67, 1.91) |
| 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                                               | 1.22 (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) |
| **Perceived family economic level**                  |                 |              |              |
| High                                                 | Reference       | Reference    | Reference    |
| Middle                                               | 1.33 (0.86, 2.05) | 1.26 (0.85, 1.95) | 1.89 (1.02, 2.80) |
| Low                                                  |                 |              |              |
| **Lifestyle and psychosocial factors**               |                 |              |              |
| Frequency of alcohol drinking (per month)            |                 |              |              |
| Never                                                | 2.10 (1.36, 3.26) | 1.94 (1.28, 3.01) | 2.34 (1.20, 4.54) |
| 1-2                                                  | 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) |
| **Smoking-related environmental factors**            |                 |              |              |
| 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, 2.61) | 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 (0.98, 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 | Reference | Reference | Reference |
| Never                                                | 1.34 (0.96, 1.86) | 1.61 (1.18, 2.20) | 1.69 (1.17, 2.44) |
| Previously                                           | 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
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 possible. 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 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 frequent, daily, or heavy smoker increased sharply in one point in time for each smoking level.
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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 in 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.

REFERENCES

1. Ellickson PL, Tucker JS, Klein DJ. High-risk behaviors associated with early smoking: results from a 5-year follow-up. J Adolesc Health 2001;28(6):465-473.
2. Mathers M, Toumbourou JW, Catalano RF, Williams J, Patton GC. Consequences of youth tobacco use: a review of prospective behavioural studies. Addiction 2006;101(7):948-958.
3. US Department of Health and Human Services. Preventing tobacco use among young people: a report of the Surgeon General. Washington, DC: US Department of Health and Human Services; 1994, p. 65-66, 107-110.
4. Breslau N, Peterson EL. Smoking cessation in young adults: age at initiation of cigarette smoking and other suspected influences. Am J Public Health 1996;86(2):214-220.
5. Chen J, Millar WJ. Age of smoking initiation: implications for quitting. Health Rep 1998;9(4):39-46.
6. Fernandez E, Schiaffino A, La Vecchia C, Borras JM, Nebot M, Salto E, et al. Age at starting smoking and number of cigarettes smoked in Catalonia, Spain. Prev Med 1999;28(4):361-366.
7. Khuder SA, Dayal HH, Mutgi AB. Age at smoking onset and its effect on smoking cessation. Addict Behav 1999;24(5):673-677.
8. Lando HA, Thai DT, Murray DM, Robinson LA, Jeffery RW, Sherwood NE, et al. Age of initiation, smoking patterns, and risk in a population of working adults. Prev Med 1999;29(6 Pt 1): 590-598.
9. Park SM, Son KY, Lee YJ, Lee HC, Kang JH, Lee YJ, et al. A preliminary investigation of early smoking initiation and nicotine de-
pendence in Korean adults. Drug Alcohol Depend 2004;74(2): 197-203.

10. Morrell HE, Song AV, Halpern-Felsher BL. Earlier age of smoking initiation may not predict heavier cigarette consumption in later adolescence. Prev Sci 2011;12(3):247-254.

11. O’Loughlin J, Karp I, Kouls T, Paradis G, Difranza J. Determinants of first puff and daily cigarette smoking in adolescents. Am J Epidemiol 2009;170(5):585-597.

12. Everett SA, Warren CW, Sharp D, Kann L, Husten CG, Crossett LS. Initiation of cigarette smoking and subsequent smoking behavior among U.S. high school students. Prev Med 1999; 29(5):327-333.

13. Reidpath DD, Ling ML, Wellington E, Al-Sadat N, Yasin S. The relationship between age of smoking initiation and current smoking: an analysis of school surveys in three European countries. Nicotine Tob Res 2013;15(3):729-733.

14. Escobedo LG, Marcus SE, Holtzman D, Giovino GA. Sports participation, age at smoking initiation, and the risk of smoking among US high school students. JAMA 1993;269(11):1391-1395.

15. Takakura M, Wake N. Association of age at onset of cigarette and alcohol use with subsequent smoking and drinking patterns among Japanese high school students. J Sch Health 2003; 73(6):226-231.

16. World Health Organization. Guidelines for controlling and monitoring the tobacco epidemic. Geneva: World Health Organization; 1998, p. 76-78.

17. Kim JY, Park SW. Predictors of current smoking among male students in a technical high school: a prospective study. J Prev Med Public Health 2009;42(1):59-66 (Korean).

18. Breslau N, Fenn N, Peterson EL. Early smoking initiation and nicotine dependence in a cohort of young adults. Drug Alcohol Depend 1993;33(2):129-137.

19. Zhu SH, Sun J, Billings SC, Choi WS, Malarcher A. Predictors of smoking cessation in U.S. adolescents. Am J Prev Med 1999; 16(3):202-207.

20. Storr CL, Ialongo NS, Kellam SG, Anthony JC. A randomized controlled trial of two primary school intervention strategies to prevent early onset tobacco smoking. Drug Alcohol Depend 2002;66(1):51-60.

21. Chung HH, Elias M, Schneider K. Patterns of individual adjustment changes during middle school transition. J Sch Psychol 1998;36(1):83-101.

22. Glynn TJ. Essential elements of school-based smoking prevention programs. J Sch Health 1989;59(5):181-188.