

Predictors of long-term smoking cessation among smokers enrolled in a university smoking cessation program

A longitudinal study

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Abstract

Many lifelong smokers establish smoking habits during young adulthood. A university can be an effective setting for early smoking cessation. We evaluated long-term predictors of smoking cessation among smokers in a university setting.

We longitudinally followed a cohort of smokers enrolled in a university smoking cessation program in Seoul, South Korea. Sociodemographic factors, smoking-related variables, and changes in smoking habits were assessed during 6-week visit sessions and follow-up telephone interviews conducted 1 year or more later.

A total of 205 participants were followed up (mean follow-up duration: 27.1 months). Cessation rates were 47.3% at the end of the visit sessions and 28.8% at follow-up. The long-term persistent smoking rate was significantly higher among individuals with peers who smoked (odds ratio [OR] = 8.64; 95% confidence interval [CI] = 1.75, 42.80), with family members who smoked (OR = 3.28; 95% CI = 1.20, 9.00), and who smoked 10 to 19 cigarettes/day (OR = 4.83; 95% CI = 1.49, 15.69). Conversely, persistent smoking was less likely among those who attended the program regularly (OR = 0.84 per visit; 95% CI = 0.72, 0.99) and attempted quitting more frequently (OR = 0.93 per attempt; 95% CI = 0.87, 0.99). Use of smoking cessation medications (varenicline or bupropion) was not significantly associated with long-term quitting (OR = 0.71; 95% CI = 0.26, 1.93).

Peer influences were the strongest predictors of failure in long-term cessation among smokers who attempted to quit. Similarly, the existence of smokers in the family was negatively associated with successful quitting. Regular attendance at a smoking cessation program and a high number of attempts to quit were positively associated with successful quitting. Targeting peer and family smoking groups together rather than targeting individual smokers alone, implementing active cessation programs encouraging regular attendance, and providing comprehensive antismoking environments might be effective strategies in a university setting.

Abbreviations: CI = confidence interval, OR = odds ratio, SD = standard deviation.

Keywords: peer smoking, smoking cessation, university setting, young adult

1. Introduction

Smoking is the single greatest preventable cause of premature death worldwide, causing many types of cancers, cardiovascular

diseases, respiratory diseases, and peptic ulcer disease.^[1,2] Smoking-related mortality continues to rise with a global estimate of 8.3 million in 2030.^[3] The risks of smoking-

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HJ and MHC are co-first authors and contributed equally to this work.

The study was approved by the Institutional Review Board of Seoul National University College of Medicine/Seoul National University Hospital (Seoul, South Korea; IRB number, H-1901-098-1004). All participants provided written informed consent before participation in the program.

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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attributable morbidities and mortalities are known to be higher with a longer smoking duration, larger numbers of cigarettes smoked, and earlier age of initiation.^[4] Therefore, it is crucial to quit smoking as early as possible. However, a large body of evidence suggests that quitting of smoking is very difficult to achieve. For individuals who tried to quit on their own, the average cessation rate was 5%,^[5] and for those using prescribed smoking cessation medications, the crude cessation rate increased by 16% compared with control groups.^[6]

Previous studies reported that young adult smokers are more likely to attempt quitting than older smokers, but tend to be unsuccessful and cycle through periods of cessation and relapse.^[7] Those who successfully quit for at least 1 year had a good chance of remaining abstinent in the long term, indicating the usefulness of promoting smoking cessation in young adulthood.^[8] In recent decades, the proportion of young adults attending universities has increased in many countries. In the United States, as of 2012, 63% of young adults aged 25 to 29 years had completed at least some college education.^[9] In Korea, 67.6% of adults were enrolled in colleges or universities in 2018.^[10] Thus, a university setting can serve as one of the most important channels to systematically reach young adults and provide an efficient and effective framework for health promotion, including smoking cessation.^[11,12] For most young adult students, numerous changes occur during the college years, including increasing independence from the family, the establishment of new peer networks, and greater exposure to risk behaviors.^[7] A university is an environment where social smoking and tobacco experimentation are common.^[13]

However, there is limited evidence on how to promote smoking cessation among university student smokers, especially those who are motivated to quit. Most of the previous studies were conducted among adolescents and adults in their early 20s who tried to quit on their own^[8,13–15] or patients with certain pre-existing diseases,^[16] and were often cross-sectional or had short follow-up periods. We, therefore, aimed to identify long-term predictors of successful cessation among smokers participating in a university smoking cessation program with a longitudinal study design. We hypothesized that there would be individual and socioenvironmental factors that might facilitate or hinder cessation in a university setting.

2. Methods

2.1. Participants and procedure

We prospectively followed a cohort of 328 smokers consecutively enrolled in a university smoking cessation program between March 2015 and December 2017 at Seoul National University, South Korea's largest public university. The smoking cessation program was provided year-round as a primary care practice at the university for all registered students, academic faculty, and non-academic staff who wanted to quit smoking. The program consisted of 6 sessions with weekly visits, including 1 group-education session on smoking cessation guidance for self-implementation and 5 individual-based sessions (one-to-one counseling with a trained counselor and a medical consultation with a doctor). Participants were allowed to extend their visit sessions as needed. Smoking cessation aids (eg, nicotine patches) and medications (varenicline and bupropion) were available for the participants. A trained nurse conducted a telephone interview from August 2018 to September 2018 for the long-term follow-up of the participants. The inclusion criteria of the present study

were those aged 18 years or over and who were followed up for more than 1 year among the cohort participants. Exclusion criteria were those who were lost to follow-up and unwilling to respond to the telephone interview. The study was approved by the Institutional Review Board of Seoul National University College of Medicine/Seoul National University Hospital (Seoul, South Korea; IRB number, H-1901–098–1004). All participants provided written informed consent before participation in the program.

2.2. Measures

On the first visit of the program (baseline), participants self-administered a questionnaire on smoking-related behaviors (age of initiation, smoking duration, daily cigarette consumption, level of nicotine dependence), smoking-related attitudes (perceived importance of, readiness for, and self-efficacy in quitting), and the presence of supporters for smoking cessation (yes/no). The level of nicotine dependence was evaluated using the shortened Fagerström Test for Nicotine Dependence,^[17] ranging from 0 (lowest) to 10 (highest). Perceived importance of quitting was assessed by the question: “How important is it to you to quit smoking now?” To assess their readiness for quitting, participants were asked “How much are you ready to quit smoking?” Self-efficacy was measured using the question: “How confident are you that you can quit in 6 weeks?” Responses on smoking-related attitudes were obtained on a scale from 0 (lowest) to 10 (highest). At every session, changes in smoking status (abstinence/continued smoking) were determined by self-report and verified by the measured level of carbon monoxide in the breath (babyCO, Vyaire Medical, Mettawa, IL), a respiratory biomarker of tobacco consumption. Data on duration of program attendance (weeks) and use and types of smoking cessation medications/aids were collected via electronic medical records.

Follow-up telephone interviews were conducted using a structured questionnaire, including both multiple-choice and qualitative questions. Participants' smoking status (abstinence/continued smoking) was evaluated by the question: “Have you smoked more than one cigarette in the past month? (yes/no).” Participants with the response “yes” were considered non-quitters, and those with “no” were considered quitters. We asked all participants their number of lifetime attempts to quit and about their social environment (number of family members and close peers who smoked). For quitters, we asked about the duration of smoking cessation after the program (months), whether there was a relapse in the interim (yes/no), the most helpful factors in quitting, the hardest part of maintaining abstinence, urge to re-smoke, and coping methods used to resist the urges. For non-quitters, we asked about the duration of smoking after the program (months), daily cigarette consumption, continuity of smoking habit (continued/relapsed), reasons for relapse into smoking, willingness to retry quitting (yes/no), and if they responded with a “yes,” we asked about their perceived importance of, readiness for, and self-efficacy in quitting.

As correlated variables, information on sociodemographic and lifestyle variables (age, sex, job, alcohol use, regular exercise) was obtained via a self-administered questionnaire at baseline. Height, weight, and blood pressure were measured by a trained nurse, and body mass index (kg/m^2) was calculated. Comorbidity (hypertension, diabetes mellitus, dyslipidemia, and hyperuricemia) was assessed based on each participant's electronic medical records.

2.3. Statistical analysis

Characteristics of the study participants were summarized as numbers and percentages for categorical variables and mean \pm standard deviation (SD) for continuous variables. To compare characteristics between quitters and non-quitters, *t* tests were used for continuous variables, and chi-squared tests were used for categorical values. To evaluate the factors associated with persistent smoking, we performed multivariate logistic regression and calculated odds ratios (ORs) and 95% confidence intervals (CIs) with adjustments for age (years); follow-up duration (months); status (student/faculty/staff); body mass index (<23 , 23 – 24.9 , ≥ 25 kg/m²); alcohol use (none/moderate/heavy); regular exercise (yes/no); comorbidity (yes/no); smoking duration (years); age of smoking initiation (14–16, 17–19, 20–39 years); cigarette consumption per day (<10 , 10–19, ≥ 20 cigarettes); score on the Fagerström Test for Nicotine Dependence (0, 1–3, 4–6, 7–10 points); perceived importance of, readiness for, and self-efficacy in quitting; number of attempts to quit; program attendance (weeks); use of smoking cessation medications (yes/no); and existence of smokers in family (yes/no), peer smokers (yes/no), and supporters for smoking cessation (yes/no). We additionally conducted similar logistic regression analyses to assess the correlates of quitting immediately after the cessation program. Among persistent smokers, paired *t* tests were conducted to assess within-person changes in cigarette consumption and smoking-related attitudes between baseline and follow-up. Missing values for each survey item were excluded from the analyses. All *P* values were 2-sided, and *P* $< .05$ was considered statistically significant. Statistical tests were performed using STATA 14.0 (StataCorp LP, College Station, TX).

3. Results

Of the 328 participants enrolled in the smoking cessation program, 47 participants were lost to follow-up and 37 were unwilling to respond to the telephone interview. In total, 244 (74.4%) were followed up through telephone interviews. Among those, 205 adults who had a follow-up duration of 1 year or more were included in this study. The mean duration of follow-up was 27.1 months (range: 14.2–41.8 months; Table 1). The mean (SD) age was 31.6 (± 10.1) years at baseline, and 71.7% were students. The average daily cigarette consumption was 13.3 (± 14.4) cigarettes, and the average Fagerström test score was 3.6 (± 2.2). The mean age of smoking initiation was 20.2 years. One in three of the participants had at least 1 family member who smoked, and 91.7% reported that they had at least 1 close peer who smoked. When the smoking cessation program was completed, the immediate cessation rate was 47.3% (*n* = 97). However, after the long-term follow-up, the proportion of quitters was 28.8% (*n* = 59). Of those who stopped smoking after 6 weeks of the program, only 40.2% (*n* = 39) remained abstinent until follow-up, and 59.8% (*n* = 58) relapsed. Of those who continued smoking at the end of the 6-week (*n* = 108), 20 participants reported that they had stopped smoking at the long-term follow-up.

Table 2 and Figure 1 present the factors associated with persistent smoking in the long term in the multivariate logistic regression. The persistent smoking rate was significantly higher among individuals with peer smokers (OR = 8.64; 95% CI = 1.75, 42.80), those with family members who smoked (OR = 3.28; 95% CI = 1.20, 9.00), and those whose smoking quantity was 10 to 19 cigarettes/day (OR = 4.83; 95% CI = 1.49, 15.69).

Persistent smoking was less likely among those who attempted quitting more frequently (OR = 0.93 per attempt; 95% CI = 0.87, 0.99) and attended the program regularly (OR = 0.84 per visit; 95% CI = 0.72, 0.99). For those who completed the full program (6 weeks), the OR (95% CI) was 0.36 (0.14, 0.96). Use of smoking cessation medications was not significantly associated with long-term quitting (OR = 0.71; 95% CI = 0.26, 1.93). None of the sociodemographic and lifestyle variables was associated with long-term cessation. We additionally evaluated factors associated with quitting immediately after the smoking cessation program (Supplementary Table S1, <http://links.lww.com/MD/D683>). In the multivariate logistic regression, the duration of program attendance was associated (*P* $< .001$) and a high level of self-efficacy was marginally associated (*P* = .05) with immediate quitting. Heavy drinkers were more likely to quit (*P* = .01), but the number of quitters among heavy drinkers was very small (*n* = 2).

The quantitative and qualitative responses to the follow-up telephone interview are presented in Table 3. Among quitters, the most frequent responses to the question on the most helpful factors in quitting were “willingness to quit” (34.7%), “use of smoking cessation medications” (30.6%), and “participation in the smoking cessation program” (24.5%). They reported difficulties in maintaining abstinence under circumstances of emotional stress (27.1%), social gatherings/pressure (18.6%), and in situations involving alcohol (18.6%). More than two third of the quitters reported urges to re-smoke, and the most frequently used coping method was endurance (65.0%). Among non-quitters, the most frequently reported reason for persistent smoking was emotional stress (61.5%). Most of them (89.0%) were still willing to retry quitting, and their cigarette consumption at follow-up significantly decreased from baseline (*P* $< .001$). We found no significant within-person changes in the levels of smoking-related attitudes between baseline and follow-up (*P* $> .31$).

4. Discussion

In our longitudinal study of smokers enrolled in a university smoking cessation program with the mean follow-up duration of 27.1 months, peer and family smoking was negatively associated with successful cessation; whereas, regular attendance at a smoking cessation program and a high number of attempts to quit were positively associated with quitting. The influences of peer and family smoking were significant in the long term rather than in the short term.

Family and peer smoking can act as important socioenvironmental triggers for smoking behavior and have negative effects on attempts to quit.^[8,13–16,18] In many previous studies, adolescents and adults with parents or other family members who smoked tended to become continuous smokers in the long term,^[8,13,19,20] while some studies in Taiwan and the United Kingdom found no association between family smoking and cessation.^[21,22] Smokers exposed to peer smoking were more likely to fail in quitting,^[14,18,22–24] although the relationship was not significant in other studies.^[8,25] Among young adults, socioenvironmental factors, such as marrying a nonsmoker, played the largest role in predicting long-term abstinence.^[8] In the present study, conducted in a university setting, social environments were the strongest predictors of smoking cessation, indicating that individuals in this setting are highly susceptible to socioenvironmental influences on use of tobacco. The effect

Table 1
Characteristics of study participants by smoking status at long-term follow-up.

	Total (N = 205)	Smoking status at long-term follow-up		P
		Quitters (N = 59)	Non-quitters (N = 146)	
Follow-up duration, month (range)	27.1 ± 9.4 (14.2–41.8)	27.4 ± 9.2 (14.2–41.8)	27.0 ± 9.5 (14.2–41.8)	.80
Age, yr	31.6 ± 10.1	31.3 ± 9.4	31.7 ± 10.4	.77
Sex, men, n (%)	197 (96.1)	59 (100.0)	139 (95.2)	.24
Status, n (%)				
Faculty	11 (5.4)	4 (6.8)	7 (7.8)	.24
Staff	47 (22.9)	9 (15.3)	38 (26.0)	
Student	147 (71.7)	46 (78.0)	101 (69.2)	
Alcohol use, n (%)				
None	13 (6.3)	3 (5.1)	10 (6.8)	.48
Moderate	172 (83.9)	53 (89.8)	119 (81.5)	
Heavy	15 (7.3)	2 (3.4)	13 (8.9)	
Regular exercise, yes, n (%)	125 (61.0)	39 (66.1)	86 (58.9)	.34
Comorbidity, yes, n (%)	23 (11.2)	10 (16.9)	13 (8.9)	.10
Body mass index, kg/m ²	24.0 ± 2.8	24.3 ± 3.2	23.9 ± 2.6	.39
Systolic blood pressure, mmHg	129.8 ± 12.8	130.7 ± 12.7	129.5 ± 12.8	.55
Diastolic blood pressure, mmHg	76.8 ± 10.6	77.2 ± 10.1	76.6 ± 10.8	.71
Exhaled carbon monoxide, ppm	11.0 ± 8.6	10.7 ± 9.9	11.1 ± 8.1	.74
Smoking duration, yr	11.9 ± 9.4	11.6 ± 8.8	12.1 ± 9.7	.78
Age of smoking initiation, yr	20.2 ± 2.9	20.0 ± 2.2	20.2 ± 3.1	.57
14–16	17 (8.3)	5 (8.5)	12 (8.2)	.43
17–19	39 (19.0)	13 (22.0)	26 (17.8)	
20–39	148 (72.2)	40 (67.8)	108 (74.0)	
Cigarette consumption per day	13.3 ± 14.4	12.1 ± 5.7	13.8 ± 16.8	.47
<10	54 (26.3)	17 (28.8)	37 (25.3)	.47
10–19	106 (51.7)	29 (49.2)	77 (52.7)	
≥20	42 (20.5)	11 (18.6)	31 (21.2)	
Fagerström Test for Nicotine Dependence, point	3.6 ± 2.2	3.2 ± 2.0	3.7 ± 2.2	.16
0 (no)	16 (7.8)	5 (8.5)	11 (7.5)	.74
1–3 (low)	87 (42.4)	27 (45.8)	60 (41.1)	
4–6 (moderate)	81 (39.5)	23 (39.0)	58 (39.7)	
7–10 (high)	21 (10.2)	4 (6.8)	17 (11.6)	
Perceived importance of quitting, point [†]	7.7 ± 2.0	7.7 ± 2.1	7.7 ± 2.0	.85
Readiness for quitting, point [†]	6.0 ± 2.3	6.2 ± 2.2	5.9 ± 2.3	.40
Self-efficacy in quitting, point [†]	5.7 ± 2.3	6.2 ± 2.2	5.5 ± 2.4	.042
Attempts to quit smoking, n	4.7 ± 8.1	6.9 ± 14.4	3.8 ± 2.6	.014
Program attendance, week	4.2 ± 2.6	4.9 ± 2.5	3.9 ± 2.5	.08
Use of smoking cessation medication, yes, [‡] n (%)	112 (54.6)	34 (57.6)	78 (53.4)	.58
Supporter for smoking cessation, yes, n (%)	180 (87.8)	54 (91.5)	126 (86.3)	.36
Smoker in family, n	0.4 ± 0.7	0.3 ± 0.5	0.5 ± 0.7	.009
0	133 (64.9)	47 (79.7)	86 (58.9)	.019
1	54 (26.3)	9 (15.3)	45 (30.8)	
≥2	18 (8.8)	3 (6.8)	15 (10.3)	
Peer smoker, n	7.1 ± 6.6	6.4 ± 4.7	7.4 ± 7.3	.33
0	17 (8.3)	9 (15.3)	8 (5.5)	.07
1–4	55 (26.8)	11 (18.6)	44 (30.1)	
5–9	66 (32.2)	19 (32.2)	47 (32.2)	
≥10	67 (32.7)	20 (33.9)	47 (32.2)	
Smoking status when the program was completed, n (%)				
Abstinence	97 (47.3)	39 (66.1)	58 (39.7)	.001
Continued smoking	108 (52.7)	20 (33.9)	88 (60.3)	

Values are numbers (percentages) or means ± standard deviations unless otherwise indicated.

Numbers do not add up to total due to missing data.

* Includes hypertension, diabetes, dyslipidemia, and hyperuricemia.

† Range: 0–10 point.

‡ Includes varenicline and bupropion.

size for peer smoking was larger than that for family smoking. A previous study suggested that as adolescents become young adults, peer influences become more important than family influences.^[22] Currently in Korea, the national smoking cessation

services are mainly based on individual counseling protocols.^[26] Our results suggest that, in a university setting, interventions involving peers and families together might be a more effective strategy than merely targeting individual smokers alone.

Table 2
Factors associated with persistent smoking at the long-term follow-up 1 year or more later.*

	Multivariate OR	(95% CI)	P	P _{trend}
Follow-up duration, month	0.95	(0.90–1.00)	.048	
Age, yr	1.02	(0.88–1.18)	.80	
Status				
Faculty	1	(ref)	–	
Staff	4.35	(0.50–37.90)	.18	
Student	0.84	(0.08–8.96)	.89	
Body mass index, kg/m ²				
<23	1	(ref)	–	
23–24.9	1.07	(0.37–3.13)	.90	
≥25	0.66	(0.25–1.78)	.41	
Alcohol use				
None	1	(ref)	–	
Moderate	1.94	(0.27–14.19)	.51	
Heavy	6.52	(0.43–99.54)	.18	
Regular exercise, yes vs no	0.48	(0.19–1.21)	.12	
Comorbidity, yes vs no [†]	0.37	(0.10–1.29)	.12	
Smoking duration, yr	0.98	(0.85–1.13)	.76	
Age of smoking initiation, yr				
14–16	1	(ref)	–	.06
17–19	0.95	(0.21–4.35)	.94	
20–39	2.81	(0.64–12.34)	.17	
Cigarette consumption, cigarette/day				
<10	1	(ref)	–	.08
10–19	4.83	(1.49–15.69)	.009	
≥20	3.43	(0.76–15.57)	.11	
Fagerström test for nicotine dependence, point				
0 (no)	1	(ref)	–	.94
1–3 (low)	0.39	(0.07–2.17)	.28	
4–6 (moderate)	0.37	(0.06–2.31)	.29	
7–10 (high)	1.01	(0.10–10.04)	.99	
Perceived importance of quitting, point [‡]	1.05	(0.85–1.31)	.65	
Readiness for quitting, point [‡]	0.93	(0.72–1.20)	.57	
Self-efficacy in quitting, point [‡]	0.79	(0.62–1.02)	.07	
Attempts to quit smoking, n	0.93	(0.87–0.99)	.029	
Program attendance, week	0.84	(0.72–0.99)	.042	
Use of smoking cessation medication, yes vs no [§]	0.71	(0.26–1.93)	.50	
Supporter for smoking cessation, yes vs no	0.23	(0.05–1.08)	.06	
Smoker in family, yes vs no	3.28	(1.20–9.00)	.021	
Smoker in family, n				
0	1	(ref)	–	.08
1	4.09	(1.33–12.60)	.014	
≥2	1.67	(0.33–8.35)	.53	
Peer smoker, yes vs no	8.64	(1.75–42.80)	.008	
Peer smoker, n				
0	1	(ref)	–	.33
1–4	13.67	(2.26–82.67)	.004	
5–9	7.00	(1.25–39.20)	.027	
≥10	7.24	(1.35–38.80)	.021	

OR = odds ratio, CI = confidence interval.

* Analyses were from multivariate logistic regression models that were adjusted for the variables in the table.

[†] Includes hypertension, diabetes, dyslipidemia, and hyperuricemia.

[‡] Range: 0–10 point.

[§] Includes varenicline and bupropion.

Notably, 91.7% of our participants reported having a close peer who smoked. This finding could imply a pattern of peer clustering in smoking behavior in a university setting, given a 10.5% rate of smoking among male university students.^[27] However, only 7.3% of the persistent smokers reported that the reason for their continued smoking was the influence of peer smoking, although peer influences were the strongest negative predictors of long-term cessation in our analyses. These results

suggest that most of the smokers were exposed to pro-smoking socioenvironmental contexts; however, in such an environment, an individual smoker may not recognize or resist the influences, contributing to a vicious cycle of continued smoking, failure in cessation, or relapse. A previous study reported that long-term abstinence was mostly promoted by antismoking socioenvironmental influences, such as smoke-free workplace policies.^[8] Thus, it will be crucial to build a comprehensive environmental

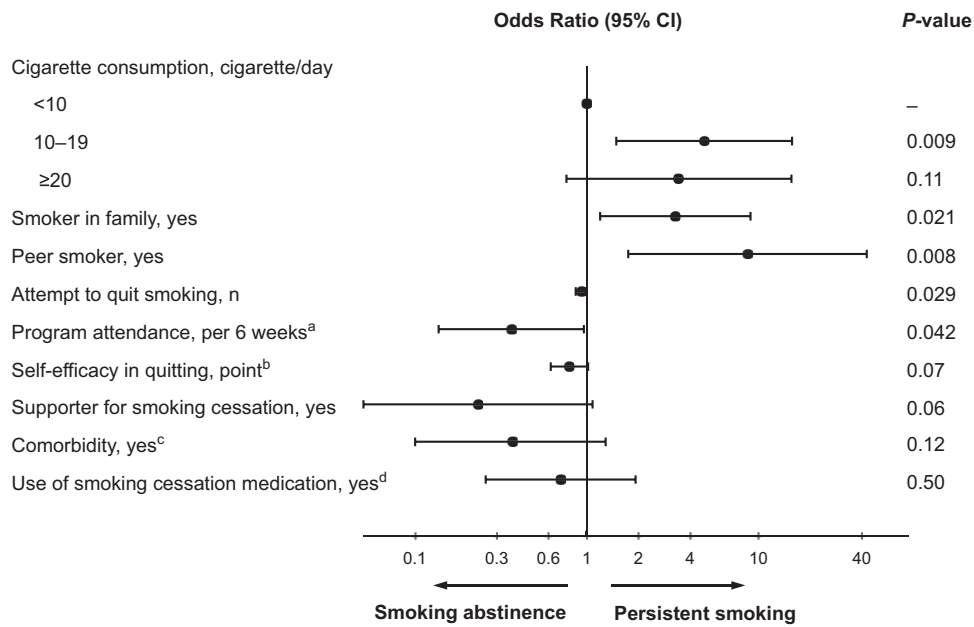


Figure 1. Predictors of long-term smoking cessation among smokers enrolled in a university smoking cessation program. ^aThe duration of the program was 6 weeks. ^bRange: 0–10 point. ^cComorbidity includes hypertension, diabetes, dyslipidemia, and hyperuricemia. ^dSmoking cessation medications include varenicline and bupropion.

barrier to smoking behaviors on campuses at a university level (eg, adoption of smoke-free campus policies).^[28] Because restriction of smoking to designated areas—as was the case in the university where the current study was conducted—failed to achieve long-term abstinence,^[8] smoke-free campus policies should be implemented in a comprehensive manner, prohibiting smoking throughout the campus.

In concordance with the results of previous studies,^[29,30] regular attendance at the smoking cessation program was significantly associated with successful quitting in both the short term and long term among our participants. Some studies reported that satisfaction with the programs, not the length of participation, was associated with quitting.^[25] As most smoking cessation programs offer guidance and personalized advice from health professionals, the association between attendance and successful quitting demonstrates the effectiveness of professionals’ roles in helping smoking cessation.^[31] Furthermore, a high attendance rate might be linked to various elements, such as personal traits (eg, willingness to implement a change), situational environments (eg, study/work burden, time to spare), and program elements (eg, practical usefulness, effectiveness). Thus, to improve participation rates of a program and thereby cessation rates, improving each of these elements will be essential.

Of the smoking-related behaviors examined in this study, a high number of attempts to quit was positively associated and the quantity of cigarettes smoked per day was negatively associated with long-term cessation. Results from previous studies on attempts to quit were mixed. Some studies reported that a high number of past attempts to quit predicted successful smoking cessation.^[32] Conversely, an inverse association was found in other studies,^[8,16,33] suggesting that those who failed to quit might tend to label themselves as failures and lose motivation to continue trying to quit.^[8] Another study suggested that not only the number but also the duration of attempts to quit were important in predicting long-term cessation.^[34]

Many previous studies reported that the degree of nicotine dependence, as indexed by daily cigarette consumption and/or the Fagerström score, was a significant predictor of quitting,^[8,35–38] although this association was not found in other studies.^[20,25] In our study, smokers with a moderate cigarette consumption were less likely to succeed in quitting than lighter smokers, with a borderline dose-response relationship ($P_{\text{trend}} = .08$). However, the number of heavy smokers (≥ 20 cigarettes/day) was relatively small among our participants. We found no association between the Fagerström score and quitting in the short and long terms.

At present, antismoking medications are considered one of the most effective cessation methods with a reported pooled risk ratio of 2.24 (95% CI=2.06, 2.43) for validated continuous quitting.^[39] Since 2015, the Korean government has provided national smoking cessation services and subsidized the costs of antismoking medications.^[26] Thus, more than half of our participants were prescribed those medications. We found that the use of smoking cessation medications was not significantly associated with quitting among young adult smokers in a university setting through multivariate logistic regression. Although more than 30% of the quitters perceived that the medications helped them quit, it would reflect a bias from lack of blinding. Our results indicate that further evidence on the cost-effectiveness of antismoking medications by subgroups of the population will be necessary in real-world clinical practice.

Similar to a previous study reporting a relapse rate of 33% after a 5-year follow-up,^[8] we found that the prevalence of relapse and urges to re-smoke were high among quitters. Among persistent smokers in our study, levels of intention to re-try quitting and self-efficacy in quitting remained high, and daily cigarette consumption had decreased significantly compared with the baseline quantity. For both quitters and non-quitters, emotional stress management was the most difficult obstacle in continuing and re-trying quitting, consistent with prior studies.^[25] Thus, to prevent relapse among quitters and to help

Table 3
Qualitative interview among study participants at the long-term follow-up.

	Quitters (N = 59)	Non-quitters (N = 146)	P*
Duration of abstinence after the program, month	17.2 ± 11.8	–	
The most helpful factors in quitting smoking			
Willingness to quit	17 (34.7)	–	
Use of smoking cessation medication	15 (30.6)	–	
Participation in the smoking cessation program	12 (24.5)	–	
Quit smoking aids (nicotine patch, etc)	4 (8.2)	–	
E-cigarettes	1 (2.0)	–	
Others	10 (17.9)	–	
The hardest part in maintaining cessation			
None	20 (33.9)	–	
Emotional stress	16 (27.1)	–	
Social gathering/pressure	11 (18.6)	–	
Situations involving alcohol	11 (18.6)	–	
Weight gain after quitting	0 (0.0)	–	
Others	1 (1.7)	–	
Urges to re-smoke			
Never	19 (32.2)	–	
Sometimes	40 (67.8)	–	
Coping method against urges†			
Endurance	26 (65.0)	–	
Drinking water	7 (17.5)	–	
Exercise	4 (10.0)	–	
Quit smoking aids	0 (0.0)	–	
Others	3 (7.5)	–	
Duration of smoking after the program, month	–	23.3 ± 10.9	
Cigarette consumption per day	–	10.2 ± 5.5	<.001
<1	–	11 (7.5)	
1–9	–	49 (33.6)	
10–19	–	63 (43.2)	
≥20	–	19 (13.0)	
Electronic cigarettes	–	4 (2.7)	
Reasons for persistent smoking (n = 109)			
Emotional stress	–	67 (61.5)	
Lack of willingness	–	11 (10.1)	
Urges after alcohol use	–	10 (9.2)	
Habitual smoking	–	9 (8.3)	
Influence of peers who smoke	–	8 (7.3)	
Withdrawal symptoms	–	1 (0.9)	
Concern about gaining weight	–	0 (0.0)	
Others	–	3 (2.7)	
Willingness to retry quitting			
No	–	16 (11.0)	
Yes	–	130 (89.0)	
Perceived importance of quitting, point‡	–	7.5 ± 2.3	.41
Readiness for quitting, point‡	–	5.7 ± 2.3	.31
Self-efficacy in quitting, point‡	–	5.5 ± 2.4	.82

Values are numbers (percentages) or means ± standard deviations.

* Within-person analyses using paired *t* test between baseline and follow-up.

† Participants were allowed to give more than one response.

‡ Range, 0–10 point.

persistent smokers quit effectively, strengthening of practical guidance on coping with stress will be necessary for clinical programs.

Our study has some limitations. First, smoking cessation in the long term was determined by self-report and not validated by biochemical tests. However, self-reported smoking status was demonstrated to have a high degree of validity,^[7,13,25] and the results of breath CO tests and self-declared smoking status were in complete agreement among the random samples (n = 51) of our participants during the visit sessions. Second, self-declared smoking status was based on a question about smoking behavior

in the past month, a relatively short period, although the mean duration of abstinence among quitters was quite long (17.2 months). Third, the participants consisted of mostly young male university students and employees, which limits the generalizability of our results to other age, sex, and occupation groups. Lastly, one-fourth of the baseline participants dropped out of the follow-up interview; thus, we were not able to rule out sampling bias. Although we observed no significant differences in socio-demographic and smoking-related variables between responders and non-responders, dropouts tended to have higher smoking rates in other studies.^[22]

Our study has several strengths. To our knowledge, this is one of the few cohort studies that focused specifically on the effects of smoking cessation programs in a university setting. Despite numerous studies that assessed predictors of self-initiated or non-aided smoking cessation, little is known about the factors associated with the outcomes of clinical interventions among smokers who were motivated to quit. We prospectively explored predictors of successful quitting, and followed up for more than 1 year and for up to 41.8 months. We enrolled a relatively homogenous group, and thus were able to reduce possible unmeasured confounding (eg, education, occupation, regions). Various sociodemographic factors were adjusted for in the analyses.

5. Conclusions

This study indicated that both individual and socioenvironmental factors served as barriers and facilitators in smoking cessation. The existence of peer and family smokers was negatively associated with successful quitting; whereas, regular attendance at a smoking cessation program and a high number of attempts to quit were positively associated with quitting. Social environments, such as peer influences, were the strongest predictors of long-term cessation in a university setting. Our findings will be useful to refine more effective interventions for smoking cessation in a university context. For instance, targeting peer and family smoking groups together rather than targeting individual smokers alone, implementing active cessation programs encouraging regular attendance, and providing comprehensive antismoking environments might be effective strategies. Future researches with longer follow-up durations in a larger population as well as intervention study designs are warranted to expand evidence in this critical population.

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