

**Factors associated with smoking relapse
among adolescents: Data from longitudinal
follow up of Quitline users in Korea**

**A Thesis Submitted to
the Department of Cancer Control and Population Health
in Partial Fulfillment of the Requirements
for the Master's Degree of Public Health**

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January 2019

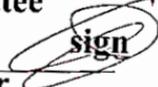
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ABSTRACT

Factors associated with smoking relapse among adolescents: Data from longitudinal follow up of Quitline users in Korea

Korea is one of the countries with high adolescent smoking prevalence, which accounts for 9.6% in boys and 2.7% in girls. To address this issue, several interventions have been implemented at multiple levels. One such efforts was the Quitline, which was implemented in 2006 to offer an intensive behavioral counseling program to help adolescent smokers to quit smoking for 1 year. In 2010, an additional motivation intervention (called Pre-Program) was introduced in this program. The present study aimed to examine the effectiveness of the youth-focused Quitline intervention and to identify factors associated with smoking relapse among adolescents, to suggest appropriate modifications to achieve successful cessation outcomes in adolescents in Korea.

This longitudinal study was conducted in Korean nationwide toll-free Quitline program. Participants included 944 adolescents aged between 13 and 19 years, who newly registered on adolescent protocol in Quitline from January 1, 2007 to December 31, 2017. Those who completed baseline information had agreed to voluntary participation were included. Among them, 407 adolescents were assigned to the pre-program, as they desired; however, only 139 adolescents continued to the main smoking cessation program. The rest of the 537 adolescents

participated only in the main program, without pre-program participation. The participants' baseline information, including sociodemographic characteristics, lifestyle behaviors, smoking-related variables, counseling process information, and social factors, was collected during registration. Cessation outcomes were assessed at 30 days, 6 months, and 1 year in all participants engaged in the main program. Logistic regression and stepwise regression were applied to identify the factors associated with smoking relapse.

The successful smoking cessation rate at 30 days, 6 months, and 1 year was 38.17%, 14.05%, and 11.98%, respectively. Characteristics of the adolescents did not differ significantly between the pre-program with main program group (Intervention 1) and the main-program without pre-program group (Intervention 2), except for quit motivation, which was higher in the group that participated in Intervention 2. The successful quit rate among adolescents who participated in Intervention 1 was higher at all follow up time points. After adjusting for appropriate covariates, Intervention 1 was found to increase successful cessation rate significantly among adolescents at the 6-month follow up. The result indicates that adolescents with high self-efficacy were less likely to relapse in both sexes. With reference to short-term smoking abstinence, adolescents who consumed alcohol had a significantly higher risk of relapse, especially among boys. Additionally, those who tended to have higher number of smoking habits to exhibit a significantly higher risk of smoking relapse. Adolescents who had higher nicotine dependence were more likely to relapse, but its effect was eliminated in

the multivariate logistic regression model. Among adolescents with low self-efficacy, sources of social support, such as peers and parents, negatively affected their successful cessation outcome. However, a limitation of this study was that we could not conduct a subgroup analysis based on quit motivation because only a small number of participants did not have the motivation to quit.

This study highlights the significant impact of the Quitline program and the pre-program motivation enhancement intervention on successful smoking cessation among adolescents, suggesting that it might be a promising youth-focused intervention. Additionally, ameliorating self-efficacy and evading environmental temptations were found to play an important role in the quitting process. Therefore, it is recommended that they be strengthened continuously to facilitate the along with maintenance of long-term smoking cessation.

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1. Introduction

1.1 Burden of tobacco use

Tobacco is the global deadliest killer, with which public health has ever been faced. According to World Health Organization (WHO) report, the burden of tobacco use is one of the biggest global issues, killing more than 7 million people a year [1], in the sense that around 19,000 people die from tobacco every day. It is predicted that tobacco will still pose a substantial problem as the deadly epidemic in the future, whereby the number of death due to tobacco will exceed eight million a year by 2030 [2]. The time has come for pressing action by reason that tobacco could kill one billion people during this century [2].

Tobacco is the leading cause of various dangerous diseases and subsequent deaths. In adults, tobacco use and second-hand smoke exposure causes serious cardiovascular and respiratory diseases such as coronary heart disease and lung cancer. It contributes to approximately 17% of all cardiovascular deaths globally, and about 3 million deaths yearly [3]. 28% of deaths in children attributable to second-hand smoke was accounted, and tobacco also causes sudden death in infant [4]. Among pregnant women, it further leads to a low birth weight situation for their babies. According to the WHO report in 2018, more than 890,000 premature deaths per year is caused by second-hand smoke [4]. Additionally, at least 10 years of smokers' is lost by tobacco [5]. In fact, tobacco is accountable to more than 90%

of tobacco-attributable death and disease, thereby combustible tobacco use is extremely hazardous to human health [5].

Most of the world's smokers live in middle-income countries. 765 million smokers (or 68% of all smokers) live in middle-income countries, which is by far the largest group of smokers in the world [1]. A slight decrease of smoking from an overall average in low-income countries (from 15.0% in 2007 to 13.2% in 2015) and in high-income countries (from 27.5% in 2007 to 23.1% in 2015) was observed [1]. Regarding to analysis of changes in the number of smokers between 2000 and 2015, there was a reduction of 62 million smokers in high-income countries, whereas the increase of 33 million smokers in low- and middle-income countries was witnessed [6]. However, high-income countries still recorded as having the group of countries with the highest average smoking rate in 2015. Unfortunately, even though the rate of global smoking is decreasing, the number of smokers have been increasing remarkably because of population growth [1].

Youth smoking is one of the biggest alarming issues in tobacco control. In many countries, there are rapid increase of tobacco prevalence among young generation. Recently, tobacco is commonly used by youths than adults in some countries such as Italy, Bulgaria, Chile, Argentina [7]. Worldwide, the number of boys and girls 13–15 years old who smoke cigarettes, are estimated approximately about 7% or over 25 million children [7]. Notably, high-income countries have the highest smoking prevalence among girls all over the world [6]. Although cigarette is the most common type of tobacco among youth worldwide, other tobacco

products are very commonly used in some populations. Globally, approximately 13 million boys and girls aged 13–15 have used smokeless tobacco products [6]. Using ‘new generation’ tobacco products (e.g. e-cigarettes, heated tobacco products) are increasing among youth, especially in very high-income countries [7]. It is worrisome that one of tobacco industries’ tactics is to target young people to fill the gap in the number of smokers in developed countries [6].

Among young people, tobacco causes short-term as well as long-term health consequences. Short-term health consequences include physical health effects, nicotine dependence, and the associated risk of other problems such as drug use. On the other hand, youth smokers for a long-term period may develop lower level of lung function, early signs of heart disease and stroke, risk smoking-related cancers, and these risks reinforces as the individual continues to smoke [8]. In the other hand, smoking is associated with other risky behaviors. For example, compared to non-smokers, adolescents who smoke face 3-fold higher risk of using alcohol, 8-fold higher risk of using marijuana, and 22-fold higher risk of using cocaine [8].

Because of smoking during childhood and adolescence, it lays the foundation for the development of serious disease in adulthood, as well as bring enormous burdens for society in the future [9]. Also, addiction to nicotine is a chronic, relapsing medical condition and should be treated. To deal with this issue, several tobacco control programs have been implemented at multi-levels to discourage adolescents from starting smoking as well as assist them quit smoking.

The major approaches include: the implementation of counter-advertising campaigns, increases in cigarette price by increasing taxation, and enforcement of regulations, laws prohibiting selling cigarettes to minors and school programs, and smoking cessation intervention programs (e.g. Quitline)

1.2 Smoking cessation among adolescent

Majority of adolescents try to quit smoking every year, but most of them are ultimately unsuccessful. Internationally, 60- 85% of young tobacco users are likely to have made at least one quit attempt and failed [10]. From another synthesis of 52 nationally representative studies, the median of the prevalence of quit attempt among adolescent was is high, at 71% (ranged from 28% to 84%). Moreover, more than a half made multiple attempts was observed [11]. However, although smoking cessation interventions for adolescents have been implemented to assist adolescent quit smoking, the study shows the high proportion of adolescents, accounted for 89% and 92%, relapsed within 6 months and 1 year respectively [11].

Therefore, understanding factors associated with smoking relapse/cessation should be focused to have insight into adolescents' smoking behaviors, it is a direct way to increase the successful quit rate. However, to date, little information on smoking behaviors and factors associated with relapse or successful quit is known.

The strong relationship between nicotine dependence and successful quit has been found in several studies. Particularly, heavy dependence on nicotine was

the chief obstacle in the path of successful smoking cessation. One prospective study in the US showed that each unit increase in nicotine dependence score, the odds of quitting were 23% lower [12]. Another study in Finland also revealed participants who highly depended on nicotine tended to not stop smoking (RR=0.1; 95% CI=0.08–0.11) [13]. Additionally, there are consistent results in other studies [14-18].

Peer friendship is a well-known factor related significantly to adolescents' smoking behaviors. In 1996, a longitudinal study was conducted to investigate predictors of smoking cessation among adolescents, Rose, J.S. identified that having friends who smoked cigarettes was associated negatively with successful cessation [14]. In Tunisia, results of El Mhamdi's study among adolescent and young adults illustrated that the risk of relapse increased by 63% in the person who had peer smokers [17]. Also, another randomized-controlled study among 15-16 years old students highlighted that a teenager whose best friend was a non-smoker had a 7-fold higher probability to stop smoking, comparing to adolescent having friend smokers [13]. The friends' influence on smoking cessation also was identified in other parts of the world like Australia, Spanish, the US, and Taiwan [12, 19-21].

An association between a family factor and adolescents' smoking cessation has been determined. Children living with family members who smoked had lower odds of stopping smoking [12, 22]. Meanwhile, parents' smoking status was a major barrier against abstinence achievement among adolescent. Those whose

parent(s) were smoker(s) were more likely to keep continuing with smoking [23-25]. Additionally, parent's smoking quitting status was associated with their children's cessation [26].

Furthermore, various factors associated with smoking cessation among adolescent were observed, including gender [14, 16, 19, 20, 27], age [20, 23, 28], age at smoking initiation [25, 29], stress [23, 24], quitting motivation [14, 18], alcohol consumption [16, 19-21], attending party [12], weekly pocket money [20], smoking attitude [14, 20, 21], self-efficacy [12, 21, 25], duration of past quit attempt [24], number cigarettes smoked [14, 16, 24, 25, 28].

However, almost evidence was suggested in the US and European countries. Studies focusing on adolescent smokers have not been paid attention properly in Asia, because of the few studies in Asian countries [21, 22, 25].

1.3 Cessation intervention programs for adolescents.

1.3.1. Review in existing smoking cessation intervention program for adolescents.

The evidence of high need for smoking cessation interventions was determined in previous part as the high quit attempt prevalence was seen in previous studies. Nevertheless, research indicates that adult cessation interventions are inadequate and inappropriate for youth [30]. The goal of reducing the

prevalence of smoking among adolescent is crucial in order to diminish long-term health risk and social burdens in the future. Therefore, to date, several appropriate and specialized tobacco cessation interventions for adolescent have been built, and implemented. In this part, I desired to briefly review in existing cessation program or interventions for adolescents, which referenced from Youth Tobacco Cessation: A guide for making informed decisions [31], a review of literature in smoking cessation intervention for youth in Ontario tobacco research unit [30] and Cochrane Library [32].

- **Brief interventions:**

Smokers are provided advised by health care workers (e.g. doctor, nurse) or other trained staffs (e.g. teacher) about the harms of tobacco use and quitting process. It is a kind of short-time face-to-face interventions (usually no more than 5 minutes), which are usually delivered to only one person at a point of time. Providers assess tobacco-related behaviors (e.g. tobacco use, nicotine dependence), and motivation to quit smoking. They provide advice on advantages, techniques of quitting, and also assist them to quit such as referrals to other cessation interventions [31]. There is a meta-analysis of seven studies show that brief advice from physicians was significantly effective in long-term smoking cessation rate, whereas insufficient evidence was seen in nurse-delivered interventions [30].

- **One-on-one, face-to-face, group counselling**

One-on-one, face-to-face counselling is the most intensive way of delivering counselling using a variety of behavior change strategies. A smoker is provided an opportunity to discuss directly and privately their problems with trained counselor. In this approach, sufficient capacity and investment in recruitment, training, and facilities must be required [31]. To date, sufficient evidence of effectiveness of one-on-one counseling have been seen among adults, however, there is lack of its effectiveness among youth [31] [32].

Group counselling involves the planned and structured delivery of behavior change strategies through a series of sessions delivered to a group of youth, not an individual. Groups often use mutual support as well as counseling by trained facilitators [31]. Similar to one-on-one counseling, there is limited evidence of group counseling's effectiveness for adolescents [31] [32].

- **Self-help, non-interactive support/computer-interactive support**

The self-help, non-interactive approach is a self-guided improvement using self-help materials such as a book, videotapes, brochures or computer program, which do not require clients' responses. Self-help interventions can be used alone or with other intensive interventions (e.g. telephone counseling, individual or group counselling). Evidence from previous studies suggests that we should integrate this intervention with more intensive cessation programs since it is more likely to be effective than using alone [31].

The computer-interactive approach uses computer-based technology such as web-based communication to assess tobacco use and motivation to quit. This intervention is interactive technique using behavior change strategies so that it can tailor counseling and feedback to clients through computer. The effectiveness of self-help, computer-interactive approach for youth is unclear [31].

- **Cognitive behavioral therapy**

The basic premise of cognitive-behavioral theory is that people can learn new behaviors to use in response to stimuli and that the thought processes that serve as an intermediate step between the stimuli and the behavior can be altered, thereby influencing behavior [31]. It includes four basic components: establishing self-awareness of tobacco use, providing quit motivation, preparing for quitting, providing strategies to maintain abstinence.

It is one promising theoretical approach to behavior change for youth tobacco-use cessation using principle of cognitive-behavioral intervention [31] [30]. Particularly, numerous reviews and meta-analysis show that cognitive behavioral and motivational enhancement interventions was effective approach to help young smoker quit smoking. They also suggested that integrating motivation enhancement and cognitive-behavioral and social influent strategies is crucial to improve cessation outcome [30].

- **Pharmacological interventions**

It is clear that this intervention is very helpful among adults, however, there is limited scientific evidence that they can help youth quit. Several systematic reviews failed to show any statistically significant results on effectiveness of pharmacotherapy among youth. Besides, other studies did not support effectiveness of NRT for adolescent smokers [31] [30]. The results from the Cochrane review shows that there is very low quality of evidence of the efficacy of pharmacological interventions for smoking cessation in young people [32].

- **Mobile-based approaches (texting/SMS/applications)**

Mobile-based approaches have numerous potential benefits including easily accessing wide and free smoking cessation resources, providing to a large number of people wherever they live, saving time and cost, and being adaptable and customizable when compared to other interventions. Nowadays, mobile-based interventions have been developed from simple short messages services (SMS) into high-quality smoking cessation apps, integrating smart tools such as self-monitoring, daily reminder. To date, evidence on effectiveness of such interventions is lacking in both adolescent and adults [30, 32]. Overall, potential benefits have been seen in SMS-based interventions in smoking cessation, but its effect in quit smoking is unknown. As a result of increase in prevalence of mobile phones, there is predicted that using mobile technologies in smoking cessation for youth are promising in the future

- **Telephone counselling**

Telephone-based tobacco cessation services (called Quitline) offer behavioral counseling to help smokers quit. Services may provide additionally self-help materials, referral to other cessation programs, and pharmacological consultation. They bring a cost-effectiveness and easily accessible smoking cessation with confidential and anonymous support to smokers wanting to quit. Quitlines use two main approaches: reactive, in which smokers initially contact to services and are provided advice and counseling whenever they need; and proactive, in which counselors ring callers back and give ongoing telephone support. The evidence of its effectiveness for adults is strong but not clear among adolescents [31]. Nevertheless, Quitline is recommended for tobacco dependence for youth according to the Oxford Centre for Evidence-based Medicine [33].

- **School-based interventions**

The results from systematic review indicate that tobacco cessation intervention should be implemented in a school environment. Particularly, several potential benefits of school-based intervention were identified, including its expansion, impact, and relatively low cost. In the school setting, such interventions enhance parental communication and positive engagement in their children's cessation process [30]. Additionally, from ideal position, school nurse or health care workers can actively involve in school-based cessation intervention to assist adolescent to quit smoking through brief counseling or develop anti-tobacco school policies [30]. Overall, there are promising effects of school-based programs

in cessation interventions among youth [30], however, further research is needed because the evidence on efficacy of school-based interventions is insufficient [33].

- **Cessation and physical activity**

Physical activity can be one of the effective approaches for youth cessation interventions because it can address psychosocial and physiological problems that NRT cannot solve. Exercise can reduce weight gain, withdrawal symptoms, stress, and cravings, as well as improve their emotion in the cessation process. There is insufficient evidence of effectiveness of this intervention among youth [33]. However, the literature reviews show promising impacts of physical activity on smoking cessation [30].

In conclusion, a summary of smoking cessation interventions in youth and their level of evidence are shown in below figure, which was cited from *Strategies to promote smoking cessation among adolescents* [33]:

Table 1: Summary of smoking cessation interventions in youth

Intervention	Recommended/ not recommended	Level of evidence
Brief counselling (in person: individual or group)	Recommended	1b
Cognitive behavioral therapy	Recommended	1b
Phone or distance counselling	Recommended	2b
Mobile phone interventions (text message reminders from a health care provider)	Recommended in combination with other interventions	2b
Self-help, noninteractive audio-visual Materials	Recommended in combination with other interventions	3b
Nicotine-replacement products (gums, patches, lozenges, sprays)	Recommended only for regular smokers 12 to 18 years of age	3b
Bupropion	Recommended in some cases, use with caution	5

Intervention	Recommended/ not recommended	Level of evidence
Varenicline	Recommended in some cases, use with caution	5
E-cigarettes	Not recommended	4
Other pharmaceuticals: Clonidine, nortriptyline, and cytisine	Insufficient evidence	–
Internet and social media-based interactive interventions	Insufficient evidence	–
School-based cessation programs	Insufficient evidence	–
Mind-body therapies and hypnosis	Insufficient evidence	–

Oxford Centre for Evidence-based Medicine – Levels of Evidence. See Levels of evidence for smoking cessation recommendations, compiled by Phillips B, Ball C, Sackett D, et al since November 1998. Updated by Jeremy Howick, March 2009: www.cebm.net/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/ (Accessed June 27, 2015)

Similar to adults, adolescent’s smoking and cessation behavior were affected by internal factors (e.g. intention to quit) and program-related factors (e.g. affordability, accessibility...). Furthermore, as mentioned in part 1.2, typical external factors such as peer friendship, family influence can also impact the success of cessation efforts in youth. For these reasons, advocating peer and family influences plays an important role in implementation of tobacco cessation interventions for adolescents. For example, peer and parental support brings positive impacts on reducing tobacco consumption as well as depression [34]. Therefore, several peer education interventions have been implemented and shows the significant results in smoking behavioral change among adolescents [35, 36].

1.3.2. Introduction of Quitline in Korea

Korea is one of the countries having the high adolescent smoking prevalence: 9.6 % in boys and 2.7% in girls [1]. In order to deal with this issue, several interventions have been implemented at multi-levels. In particular, tobacco selling to adolescents was prohibited under the legislation, along with school-based smoking cessation intervention program have been applied. One of these interventions, Quitline service, approaches adolescent smokers nationwide effectively.

Quitline service has been launched since 2006, which issues the confidentiality and accessibility for adolescent smokers with intensive and comprehensive behavioral counselling during 1-year follow-up. Initially, Quitline protocol for adolescent was designed to resemble a cessation protocol for adults. Smokers who would like to quit smoking contact Quitline and are provided intensive seven telephone calls during first 30 days and 14 additional calls over the next 11 months for smoking cessation and maintenance (main-program) [37]. Since 2010, Quitline have been offered supplementary specialized program (called Pre-Program), which includes eight in-depth counselling calls (two times per week) within 30 days before moving to main 1-year counselling protocol. Pre-program gives adolescent good chances for acclimatizing to smoking abstinence and practical experiences in attempt to quit smoking, thereby strongly motivating and promoting them to achieve better outcome in main program. Before assignation, adolescent smokers were assessed motivation to quit, tobacco-use

behavior, and were adequately explained Quitline protocols of cessation process as well as main purpose of Pre-program. Thereafter, adolescents can voluntarily select their actions with Pre-program or without Pre-program participation.

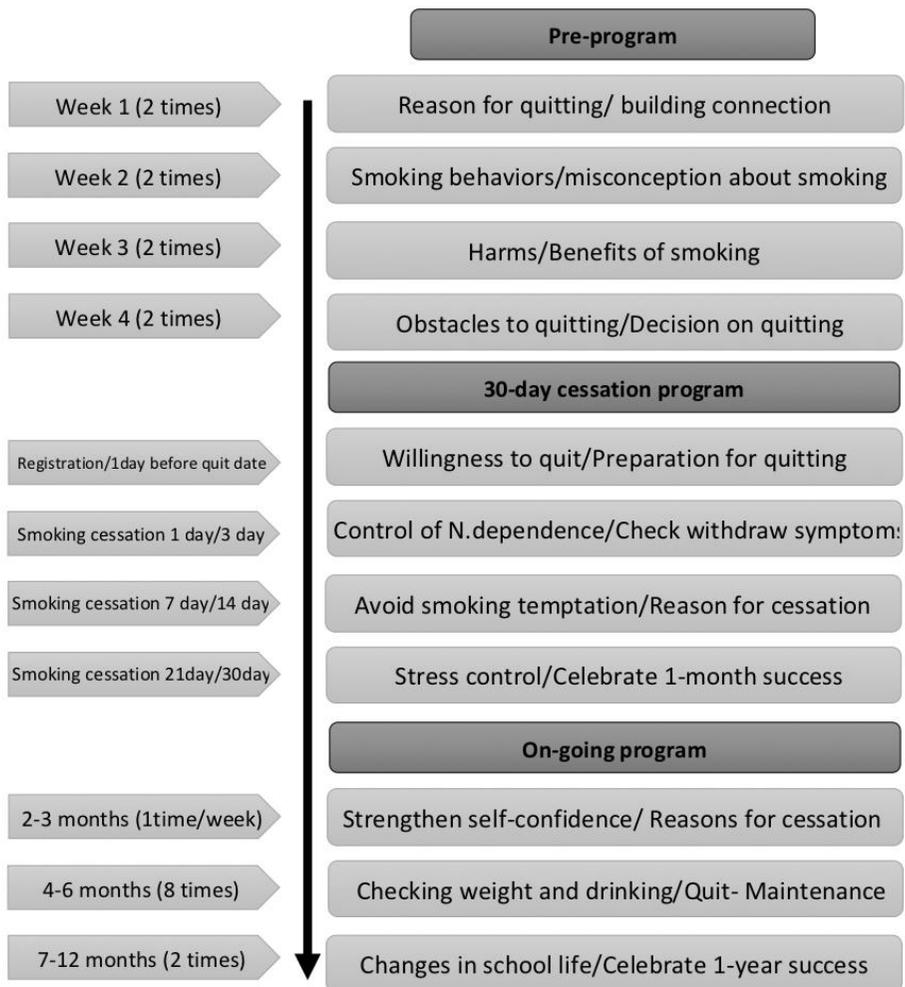


Figure 1: Summary of pre-program and main-program protocol in Quitline

1.4 Rational of study

After long-term implementation progress of Quitline system in Korea, in order to considerably ameliorate Quitline service's effectiveness, analysis on the adolescent Quitline users is meaningful to understand adolescents' cessation behaviors and associated factors, thereby suggesting appropriate adjustments to achieve successful cessation outcome for adolescents.

1.5 Objectives

A primary purpose of this study is to increase successful cessation rate among adolescent using Quitline service. For this purpose, we have 2 specific objectives in this study as below:

1. To investigate characteristics of adolescent Quitline users
2. To examine effectiveness of Quitline interventions in among adolescent smokers
3. To identify the factors associated with smoking relapse among adolescents.

2. Methods

2.1. Study design and study population

The longitudinal study was conducted in Korean nationwide toll-free Quitline, which has been operated by the National Cancer Center Korea since 2006. All adolescent who enrolled in Quitline were offered intensive counselling/advices on smoking cessation services during 1 year follow up.

From 1st January 2007 to 31st December 2017, a total of 2,673 adolescent smokers first registered in a 1-year program of Quitline service. 944 adolescents aged 13-19 years, voluntarily participated, completed baseline information, and used protocol for adolescent in Quitline was included. Before assignation, all adolescent participants were assessed motivation to quit, tobacco-use behavior and were adequately explained Quitline protocols of cessation process as well as main purpose of Pre-program. Among them, 407 of adolescents was assigned in pre-program as their desire, while the rest did not want to participate in pre-program. After using pre-program, only 139 adolescents continued to involve in main cessation program. As shown in figure, after one year follow up, the number of adolescents who relapsed within 30 days, 6 months and 1 year were 79, 112 and 119 respectively in group using only main-program. Among adolescent using both pre-program and main program, 339, 469 and 479 adolescents relapsed in 30 days, 6 months and 1 year correspondingly.

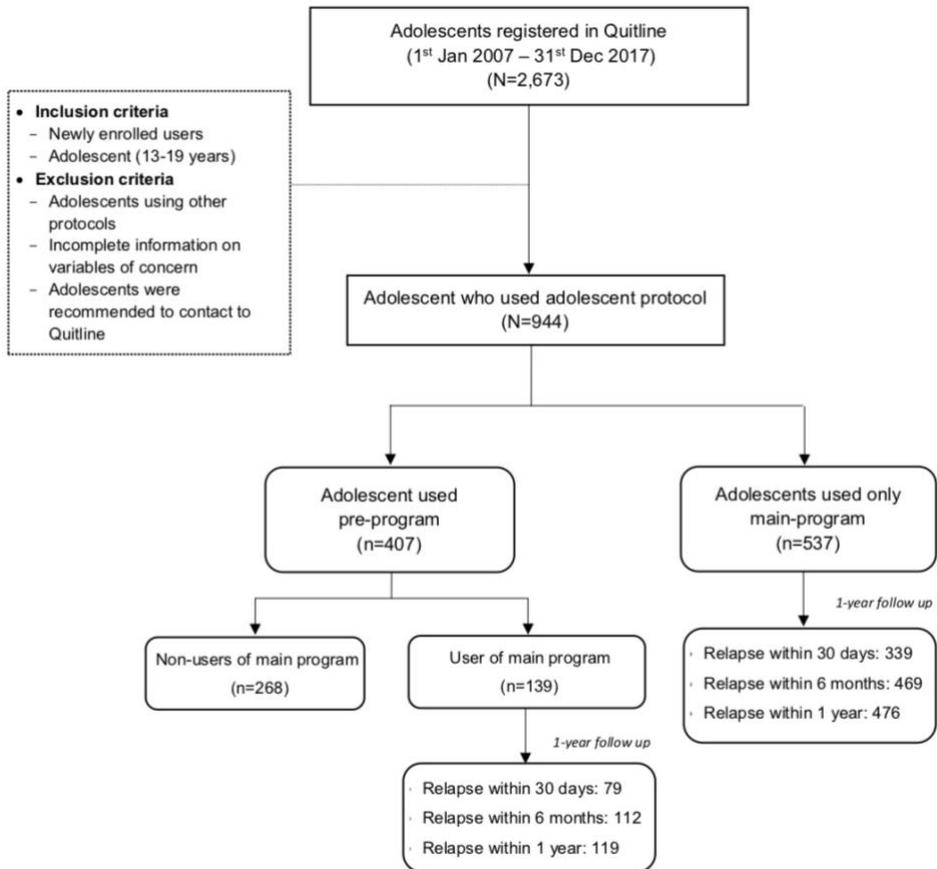


Figure 2: A flowchart of study population

2.2. Measures

The baseline information including sociodemographic characteristics, lifestyle behaviors, smoking-related variables, counseling process information and social factors were collected at registration.

Socio-demographic characteristics, and lifestyle behaviors

Socio-demographic characteristics included gender (boy or girl), age at enrollment (13-14, 15-16, 17-19 years old). Lifestyle-related variables consisted of alcohol consumption (yes or no).

Smoking-related variables

Smoking-related variables were measured: age at smoking initiation, nicotine dependence, self-efficacy. Age at smoking initiation was categorized as less than or equal 13, 14-16, 17-19 years old. Nicotine dependence was measured by using Fagerstrom Test for Nicotine Dependence [38], which was classified into mild (0-3), moderate (4-6) and severe (7-10). Number of cigarettes smoked daily was obtained, including three groups: less than 10 cigarettes, 10-19 cigarettes and more than 20 cigarettes smoked per day. Self-confidence score was measured at baseline and was coded low (0-2), moderate (3-5), high (6-8), based on Self efficacy Scale [39]. Smoking habit was asked, including 7 categorizations: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments (when seeing others smoking, when watching actors in the TV smoking), smoking when having emotions or feelings (stressed, excited, tired), smoking when being alone, smoking relating some activities (after walking, before go to bed, after taking shower, when answering phone, playing game) or others. Number of smoking habits was calculated, which was classified into 3 groups: 0-1 habit, 2 habits and higher 3 habits.

Quitline counselling-related variables and social factors

Type of Quitline protocols consist of intervention 1 (using both pre-program and main-program) and intervention 2 (using only main program without pre-program). Motivation of quitting also was asked, which is categorized as follow: personal health issue, for self-confidence, economic related issue, for good interpersonal relationship, bad attention from others, family/teacher/friends'

recommendation and others. Social factor was assessed by measuring having quit supporter (family members, friends, teachers, doctors, others) or not at baseline.

Outcomes

Outcome variables were smoking relapse within 30 days, 6 months and one year of abstinence. Relapse was assessed by adolescents' self-report and was defined as adolescent who have smoked even one puff after his/her registration in duration of follow up. In the study framework, we only assessed smokers' first relapse using Quitline assistance.

3.3. Statistical analysis

Descriptive analysis (frequency and percent) was performed to access all variables. A Chi-square test was utilized to determine significant difference between kinds of protocols and concern variables, and if expected frequencies in one cell is less than 5, Fisher Exact test would be used instead. In order to identify any correlation between ordinal variables, Spearman correlation coefficient (ρ) was calculated. Logistic regression was applied to identify association between cessation outcome and sociodemographic characteristics, lifestyle behaviors, smoking behaviors, social factors. We used stepwise logistic regression for selecting the best models. The odds ratio (OR) and 95% confidence interval (CI) were used to estimate the association. $P < 0.05$ was considered to be statistical significance. All statistical analysis was performed by using STATA (version 14.0) software.

2.4. Ethics:

All study protocol and process were approved by institutional review board in the National Cancer Center of Korea (NCC 2017-0143).

3. Results

3.1. Characteristics of study participants

Table 1 shows baseline characteristics of adolescent Quitline users in this study. In general, the majority of adolescent smokers were boys (80.03%), aged 17-19 (70.41%). Most of adolescent initiated smoking at primary school and secondary school (24.03% and 68.36%, respectively). Almost two thirds had low nicotine dependence and had drunk alcohol. There was the high proportion of adolescent having quit supporter such as peer, teacher, family members. The percentage of adolescent smokers having smoking habits was very high at 97.04%. Only 20% adolescent smokers reported that they had low self-efficacy. In terms of motivation, almost adolescents (95.71%) who registered in Quitline had motivations to quit smoking. Overall, general characteristics are quite similar in both protocol groups, but there was significant different in motivation of quitting. Proportion of adolescent had quit motivation in intervention 1 was significantly lower than that of intervention 2 (89.93% and 97.21%, respectively).

Table 2 and table 3 present overall characteristics of boy and girl smokers respectively. Most of participants aged 17 to 19 years, had supporter, had motivations of quitting, and had smoking habits. Around 60% of respondents of boys and girls had low nicotine dependence and had drunk alcohol. Chi-square test results illustrated significant difference in motivations of quitting in two protocol groups among boys, but not girls.

Table 2: Baseline characteristics of adolescent Quitline users by intervention

Characteristics	Total (n=676)		Intervention 1 ^β (n=139)		Intervention 2 [¶] (n=537)		P- value
	n	%	n	%	n	%	
Sex							
Boy	541	80.03	111	79.86	430	80.07	0.954
Girls	135	19.97	28	20.14	107	19.93	
Age							
13-16	200	29.59	33	23.74	167	31.1	0.090
17-19	476	70.41	106	76.26	370	68.9	
Supporter							
Peers	147	22.14	29	21.32	118	22.35	0.118
None	142	21.39	28	20.59	114	21.59	
Adults	368	55.42	75	55.15	293	55.49	
Others	7	1.05	4	2.94	3	0.57	
Daily cigarette consumption							
<10	267	40.39	53	40.77	214	40.3	0.413
10-19	241	36.46	42	32.31	199	37.48	
>=20	153	23.15	35	26.92	118	22.22	
Age at smoking initiation							
<=13	161	24.03	29	21.64	132	24.63	0.338
14-16	458	68.36	91	67.91	367	68.47	
17-19	51	7.61	14	10.45	37	6.9	
Nicotine dependence							
0-3	421	62.28	84	60.43	337	62.76	0.352
4-6	212	31.36	49	35.25	163	30.35	
7-10	43	6.36	6	4.32	37	6.89	
Alcohol consumption							
No	261	39.01	50	37.04	211	39.51	0.598
Yes	408	60.99	85	62.96	323	60.49	
Motivations of quitting							
No	29	4.29	14	10.07	15	2.79	0.000
Yes	647	95.71	125	89.93	522	97.21	
Numbers of smoking habits [†]							
No	20	2.96	3	2.16	17	3.79	0.532
Yes	656	95.71	136	97.84	520	96.83	
Self-efficacy							
0-2	136	20.12	26	18.71	110	20.48	0.832
3-5	302	44.67	65	46.76	237	44.13	
6-8	238	35.21	48	34.53	190	35.38	

^β Intervention 1: using both pre-program and main-program;

[¶] Intervention 2: using only main program without pre-program;

[†] Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

Table 3: Baseline characteristics of boy Quitline users by intervention

Characteristics	Boys (n=541)		Intervention 1 ^β (n=111)		Intervention 2 [¶] (n=430)		P-value
	n	%	n	%	n	%	
Age							
13-16	163	30.13	24	21.62	139	32.33	0.028
17-19	378	69.87	87	78.38	291	67.67	
Supporter							
Peers	114	21.43	24	22.02	90	21.28	0.512
None	124	23.31	26	23.85	98	23.17	
Adults	290	54.51	57	52.29	233	55.08	
Others	4	0.75	2	1.83	2	0.47	
Daily cigarette consumption							
<10	209	39.66	38	37.25	171	40.24	0.375
10-19	191	36.24	34	33.33	157	36.94	
>=20	127	24.1	30	29.41	97	22.82	
Age at smoking initiation							
<=13	132	24.67	25	23.58	107	24.94	0.169
14-16	361	67.48	68	64.15	293	68.3	
17-19	42	7.85	13	12.26	29	6.76	
Nicotine dependence							
0-3	336	62.11	64	57.66	272	63.26	0.211
4-6	170	31.42	42	37.84	128	29.77	
7-10	35	6.47	5	4.50	30	6.98	
Alcohol consumption							
No	209	39.07	41	37.96	168	39.34	0.793
Yes	326	60.93	67	62.04	259	60.66	
Motivations of quitting							
No	19	3.51	12	10.81	7	1.63	0.000
Yes	522	96.49	99	89.19	423	98.37	
Number of smoking habits [†]							
No	18	3.33	2	1.80	16	3.72	0.315
Yes	523	96.67	109	98.2	414	96.28	
Self-efficacy							
0-2	103	19.04	20	18.02	83	19.3	0.954
3-5	241	44.55	50	45.05	191	44.42	
6-8	197	36.41	41	36.94	156	36.28	

^β Intervention 1: using both pre-program and main-program;

[¶] Intervention 2: using only main program without pre-program;

[†] Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

Table 4: Baseline characteristics of girl Quitline users by intervention

Characteristics	Girl (n=135)		Intervention 1 ^β (n=28)		Intervention 2 [¶] (n=107)		P-value
	n	%	n	%	n	%	
Age							
13-16	37	27.41	9	32.14	28	26.17	0.528
17-19	98	72.59	19	67.86	79	73.83	
Supporter							
Peers	33	25.00	5	18.52	28	26.67	0.122
None	18	13.64	2	7.41	16	15.24	
Adults	78	59.09	18	66.67	60	57.14	
Others	3	2.27	2	7.41	1	0.95	
Daily cigarette consumption							
<10	58	43.28	15	53.57	43	40.57	0.442
10-19	50	37.31	8	28.57	42	39.62	
>=20	26	19.4	5	17.86	21	19.81	
Age at smoking initiation							
<=13	29	21.48	4	14.29	25	23.36	0.391
14-16	97	71.85	23	82.14	74	69.16	
17-19	9	6.67	1	3.57	8	7.48	
Nicotine dependence							
0-3	85	62.96	20	71.43	65	60.75	0.561
4-6	42	31.11	7	25.00	35	32.71	
7-10	8	5.93	1	3.57	7	6.54	
Alcohol consumption							
No	52	38.81	9	33.33	43	40.19	0.514
Yes	82	61.19	18	66.67	64	59.81	
Motivations of quitting							
No	10	7.41	2	7.14	8	7.48	0.952
Yes	125	92.59	26	92.86	99	92.52	
Number of smoking habits [†]							
No	2	1.48	1	3.57	1	0.93	0.304
Yes	133	98.52	27	96.43	106	99.07	
Self-efficacy							
0-2	33	24.44	6	21.43	27	25.23	0.601
3-5	61	45.19	15	53.57	46	42.99	
6-8	41	30.37	7	25.00	34	31.78	

^β Intervention 1: using both pre-program and main-program;

[¶] Intervention 2: using only main program without pre-program;

[†] Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

3.2. Cessation outcome

Cessation outcomes at 30-day, 6-month and 1-year follow-up are shown in table 4. In general, success rate at 30 days, 6 months and 1 year were 38.17%, 14.05% and 11.98%, respectively. By gender, success rate at 30 days was higher in boys than girls (boys: 38.82% and girls: 35.56%), but it was lower at 1 year (boys:11.65% and girls: 13.33%). Regarding Quiline protocol, successful quit rate among adolescent who used both pre-program and main program was higher at any follow-up time points in total and boys. However, among girls, success rate at 1-year follow-up of program combining pre-and main program was lower than those utilized only main program. Significant differences in cessation outcome between intervention groups were determined at 6-month follow-up in total and boys, but not girls.

Table 5: Cessation outcome at 30-day, 6-month, and 1-year follow-up by Quitline protocol

	Overall	Intervention 1 ^β		Intervention 2 [¶]		P-value
	n	n	%	n	%	
Total (n=676)						
Cessation outcome within 30 days						
Success	258	60	43.17	198	36.87	0.173
Relapse	418	79	56.83	339	63.13	
Cessation outcome within 6 months						
Success	95	27	19.42	68	12.66	0.041
Relapse	581	112	80.58	469	87.34	
Cessation outcome within 1 year						
Success	81	20	14.39	61	11.36	0.327
Relapse	595	119	85.61	476	88.64	
Boys (n=541)						
Cessation outcome within 30 days						
Success	210	48	43.24	162	37.67	0.283
Relapse	331	63	56.76	268	62.33	
Cessation outcome within 6 months						
Success	76	24	21.62	52	12.09	0.010
Relapse	465	87	78.38	378	87.91	
Cessation outcome within 1 year						
Success	63	17	15.32	46	10.7	0.176
Relapse	478	94	84.68	384	89.3	
Girls (n=135)						
Cessation outcome within 30 days						
Success	48	12	42.86	36	33.64	0.365
Relapse	87	16	57.14	71	66.36	
Cessation outcome within 6 months						
Success	19	3	10.71	16	14.95	0.566
Relapse	116	25	89.29	91	85.05	
Cessation outcome within 1 year						
Success	18	3	10.71	15	14.02	0.647
Relapse	117	25	89.29	92	85.98	

^β Intervention 1: using both pre-program and main-program;

[¶] Intervention 2: using only main program without pre-program;

3.3. Factors associated with smoking relapse

3.3.1. Factors associated with smoking relapse at 30-day follow-up

Table 5 show logistic regression analyses that examine the factors associated with smoking relapse at 30-day follow-up. The results from univariate logistic regression showed that nicotine dependence, alcohol consumption, number of smoking habits and self-efficacy were the factors significantly associated with smoking relapse. However, after adjusting all appropriate variables, only alcohol consumption and self-efficacy were correlated with smoking relapse. Adolescent who utilized alcohol was more likely to relapse, compared with those did not drink (OR= 1.588; 95% CI =1.116-2.261). Higher self-efficacy reduced the risk of smoking relapse (3-5: OR=0.499; 95%CI=0.298-0.836 and 6-8: OR=0.222; 95%CI=0.129-0.382). The final model includes only alcohol consumption and self-efficacy by using stepwise regression.

Table 6 and table 7 reveal the factors related to smoking relapse at 30-day follow-up among boys and girls respectively. Both tables show that nicotine dependence, alcohol consumption, number of smoking habits and self-efficacy were predictors of smoking relapse by using univariate logistic analysis. In multivariate logistic regression, alcohol consumption, number of smoking habits and self-efficacy were significantly related to relapse among boys, but only self-efficacy showed significant result among girls. Stepwise regression method shows in both sex that adolescents having higher self-efficacy were less likely to relapse. Specially, alcohol consumption is one important factor which predicted smoking relapse for boys only.

Table 6: Logistic regression model of relapse at 30 days follow-up (n=676)

Characteristics	Smoking relapse 418 (61,83)	Univariate model		Multivariate model*		Stepwise model	
		OR	95% CI	OR	95% CI	OR	95% CI
Gender							
Boy	331 (61.18)	1		1			
Girl	87 (64.44)	1.150	0.777-1.703	1.0644	0.693-1.634		
Age							
13-16	118 (59.00)	1		1			
17-19	300 (63.03)	1.185	0.845-1.660	0.9774	0.671-1.423		
Supporter							
None	96 (67.61)	1		1			
Peer	96 (65.31)	0.902	0.553-1.470	1.134	0.670-1.919		
Parent/Family/Teacher/Others	219 (58.40)	0.673	0.448-1.011	0.811	0.525-1.252		
Nicotine dependence							
0-3	239 (56.77)	1		1			
4-10	179 (70.20)	1.794	1.289-2.496	1.199	0.829-1.733		
Alcohol consumption							
No	133 (50.96)	1		1		1	
Yes	281 (68.87)	2.129	1.545-2.934	1.588	1.116-2.261	1.716	1.222-2.411
Number of smoking habits†							
0-1 habits	114 (51.82)	1		1			
2 habits	156 (63.16)	1.594	1.101-2.307	1.292	0.863-1.935		
>=3 habits	148 (70.81)	2.256	1.514-3.361	1.519	0.977-2.361		

Characteristics	Smoking relapse 418 (61,83)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Self-efficacy							
0-2	112 (82.35)	1		1		1	
3-5	103 (67.22)	0.439	0.266-0.726	0.499	0.298-0.836	0.461	0.278-0.766
6-8	103 (43.28)	0.163	0.098-0.272	0.222	0.129-0.382	0.193	0.115-0.324
Kind of protocol [¥]							
Intervention 1	79 (56.83)	1		1			
Intervention 2	339 (63.13)	1.300	0.890-1.899	1.262	0.833-1.913		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

¥ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 7: Logistic regression model of relapse at 30 days follow-up among boy smokers (n=541)

Characteristics	Smoking relapse 331 (61.18)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Age							
13-16	94 (57.67)	1		1			
17-19	237 (62.70)	1.234	0.849-1.794	1.01	0.663-1.538		
Supporter							
None	82 (66.13)	1		1			
Peer	73 (64.04)	0.912	0.535-1.555	1.197	0.673-2.129		
Adults	171 (58.16)	0.712	0.459-1.104	0.881	0.551-1.409		
Nicotine dependence							
0-3	191 (56.85)	1		1			
4-10	140 (68.29)	1.635	1.135-2.355	1.099	0.73-1.654		
Alcohol consumption							
No	105 (50.24)	1		1		1	
Yes	222 (68.10)	2.114	1.479-3.023	1.612	1.086-2.391	1.748	1.197-2.550
Number of smoking habits†							
0-1 habit	96 (51.89)	1		1			
2 habits	118 (60.20)	1.403	0.934-2.105	1.228	0.792-1.906		
>=3 habits	117 (73.12)	2.523	1.603-3.969	1.668	1.016-2.738		
Self-efficacy							
0-2	86 (83.50)	1		1		1	
3-5	160 (66.39)	0.390	0.218-0.701	0.436	0.239-0.795	0.408	0.226-0.736
6-8	85 (43.15)	0.150	0.083-2.711	0.205	0.109-0.383	0.182	0.100-0.333
Kind of protocol‡							
Intervention 1	63 (56.76)	1		1			
Intervention 2	268 (62.33)	1.260	0.826-1.924	1.265	0.795-2.014		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 8: Logistic regression model of relapse at 30 days follow-up among girl smokers (n=135)

Characteristics	Smoking relapse 87 (64.44)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Age							
13-16	24 (64.86)	1		1			
17-19	63 (64.29)	0.975	0.442-2.151	0.759	0.313-1.842		
Supporter							
None	14 (77.78)	1		1			
Peer	23 (69.70)	0.657	0.173-2.501	0.776	0.185-3.245		
Adults	48 (59.26)	0.416	0.126-1.375	0.466	0.131-1.648		
Nicotine dependence							
0-3	48 (56.47)	1		1			
4-10	39 (78.00)	2.733	1.235-6.050	1.738	0.715-4.228		
Alcohol consumption							
No	28 (53.85)	1	1	1			
Yes	59 (71.95)	2.199	1.062-4.552	1.284	0.539-3.058		
Number of smoking habits†							
0-1 habit	18 (51.43)	1		1			
2 habits	38 (74.51)	2.761	1.106-6.888	1.806	0.586-5.566		
>=3 habits	31 (63.27)	1.626	0.674-3.927	1.257	0.435-3.629		
Self-efficacy							
0-2	26 (78.79)	1		1		1	
3-5	43 (70.49)	0.643	0.237-1.747	0.795	0.276-2.292	0.707	0.256-1.948
6-8	18 (43.90)	0.211	0.075-0.595	0.306	0.097-0.964	0.199	0.070-0.565
Kind of protocol‡							
Intervention 1	16 (57.14)	1		1			
Intervention 2	71 (66.36)	1.479	0.633-3.458	1.13	0.424-3.014		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

3.3.2. Factors associated with smoking relapse at 6-month follow-up

Table 8 shows logistic regression models of smoking relapse at 6-month follow-up. Result from univariate logistic unveils that alcohol consumption, number of smoking habits, self-efficacy and Quitline intervention were predictors of smoking relapse at 6-month. However, in stepwise selection, only self-efficacy and Quitline intervention was significantly associated with smoking relapse. In particular, the likelihood of relapse increased among adolescents who used only main program (OR=1.700; 95%CI=1.017-2.825), compared with those using pre-program and main program.

Logistic regressions for smoking relapse at 6-month follow-up by gender are displayed in Table 9 and Table 10. For male adolescents, self-efficacy and Quitline intervention were also determinants of smoking relapse in both multivariate logistic and stepwise model. In contrast, among girls, the only significant relationship was seen between self-efficacy and smoking relapse.

Table 9: Logistic regression model of relapse at 6 months follow-up (n=676)

Characteristics	Smoking relapse 581 (85.95)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Male	456 (85.95)	1		1			
Girl	116 (85.93)	0.998	0.580-1.716	0.874	0.496-1.540		
Age							
13-16	176 (88.00)	1		1			
17-19	405 (85.08)	0.778	0.474-1.277	0.681	0.402-1.154		
Supporter							
None	126 (88.73)	1		1			
Peers	125 (85.03)	0.722	0.362-1.438	0.889	0.432-1.832		
Adults	319 (85.07)	0.723	0.400-1.308	0.865	0.468-1.600		
Nicotine dependence							
0-3	354 (84.09)	1		1			
4-10	227 (89.02)	1.534	0.958-2.459	1.136	0.677-1.905		
Alcohol consumption							
No	214 (81.99)	1		1			
Yes	362 (88.73)	1.728	1.113-2.684	1.499	0.930-2.416		
Number of smoking habits [†]							
0-1 habits	180 (81.82)	1		1			
2 habits	213 (86.23)	1.392	0.846-2.292	1.084	0.637-1.843		
≥3 habits	188 (89.95)	1.989	1.129-3.505	1.343	0.730-2.468		

Characteristics	Smoking relapse 581 (85.95)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Self-efficacy							
0-2	129 (94.85)	1		1		1	
3-5	267 (88.41)	0.414	0.179-0.957	0.450	0.192-1.057	0.425	0.183-0.987
6-8	185 (77.73)	0.189	0.083-0.430	0.232	0.098-0.548	0.197	0.086-0.448
Kind of protocol [‡]							
Intervention 1	112 (80.58)	1		1		1	
Intervention 2	469 (87.34)	1.663	1.017-2.717	1.666	0.990-2.804	1.695	1.017-2.825

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 10: Logistic regression model of relapse at 6 months follow-up among boy smokers (n=541)

Characteristics	Smoking relapse 465 (85.95)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Age							
13-16	143 (87.73)	1		1			
17-19	322 (85.19)	0.804	0.465-1.390	0.746	0.413-1.349		
Supporter							
None	111 (89.52)	1		1			
Peer	98 (85.96)	0.717	0.329-1.566	0.908	0.401-2.054		
Adult	248 (84.35)	0.631	0.328-1.216	0.746	0.379-1.468		
Nicotine dependence							
0-3	284 (84.52)	1		1			
4-10	181 (88.29)	1.381	0.822-2.319	1.064	0.6-1.885		
Alcohol consumption							
No	173 (82.78)	1		1			
Yes	288 (88.34)	1.577	0.963-2.583	1.406	0.821-2.407		
Number of smoking habits†							
0-1 habit	152 (82.16)	1		1			
2 habits	170 (86.73)	1.420	0.812-2.482	1.193	0.66-2.154		
>=3 habits	143 (89.38)	1.826	0.975-3.422	1.198	0.608-2.36		
Self-efficacy							
0-2	98 (95.15)	1		1		1	
3-5	212 (87.97)	0.373	0.140-0.993	0.406	0.149-1.101	0.390	0.146-1.045
6-8	155 (78.68)	0.188	0.072-0.492	0.225	0.082-0.617	0.200	0.076-0.525
Kind of protocol‡							
Intervention 1	87 (78.38)	1		1		1	
Intervention 2	378 (87.91)	2.005	1.172-3.430	1.966	1.112-3.477	2.019	1.156-3.528

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 11: Logistic regression model of relapse at 6 months follow-up among girl smokers (n=135)

Characteristics	Smoking relapse 116 (85.93)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Age							
13-16	33 (89.19)	1		1			
17-19	83 (84.69)	0.671	0.207-2.170	0.594	0.169-2.087		
Supporter							
None	15 (83.33)	1		1			
Peer	27 (81.82)	0.900	0.196-4.127	0.906	0.173-4.753		
Adult	71 (87.65)	1.420	0.348-5.789	1.624	0.355-7.428		
Nicotine dependence							
0-3	70 (82.35)	1		1			
4-10	46 (92.00)	2.460	0.769-7.892	1.672	0.451-6.199		
Alcohol consumption							
No	41 (78.85)	1		1			
Yes	74 (90.24)	2.482	0.925-6.662	2.245	0.669-7.53		
Number of smoking habits†							
0-1 habit	28 (80.00)	1		1			
2 habits	43 (84.31)	1.344	0.438-4.120	0.397	0.086-1.822		
>=3 habits	45 (91.84)	2.813	0.754-10.490	1.328	0.298-5.908		
Self-efficacy							
0-2	31 (93.94)	1		1		1	
3-5	55 (90.16)	0.591	0.112-3.110	0.544	0.098-3.035	0.559	0.106-2.943
6-8	30 (73.17)	0.176	0.040-0.861	0.160	0.027-0.941	0.170	0.035-0.834
Kind of protocol‡							
Intervention 1	25 (89.29)	1		1			
Intervention 2	91 (85.05)	0.683	0.184-2.530	0.912	0.223-3.731		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

3.3.3. Factors associated with smoking relapse at 1-year follow-up

Table 11 reveals factors associated with smoking relapse at 1-year follow-up by using logistic regression. In univariate logistic, the risk of relapse increased with drinking alcohol (OR=1.712; 95%CI=1.069-2.744), increasing number of smoking habits (more than 3 smoking habits: OR=2.282; 95% CI=1.222-4.263) and higher self-efficacy (6-8: OR=0.209; 95%CI=0.092-0.477). In the stepwise model, higher self-efficacy was negative effect for smoking relapse (6-8: OR=0.217; 95%CI=0.095-0.495). Also, results of stepwise model are similar among both boys and girls, which indicates only self-efficacy was significantly associated with smoking relapse at 1-year follow-up (Table 12 and Table 13).

In summary, self-efficacy was a crucial factor which significantly related to smoking relapse at all follow-up time point among both boys and girls. For boys, drinking alcohol was one of the predictors of smoking relapse at 30-day follow-up. In addition, using both pre-and main program decreased the risk of relapse at 6-month among male adolescents.

Table 12: Logistic regression model of relapse at 1-year follow-up (n=676)

Characteristics	Smoking relapse 595 (88.02)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	478 (88.35)	1		1			
Girl	117 (86.67)	0.857	0.489-1.502	0.727	0.403-1.311		
Age							
13-16	179 (89.50)	1		1			
17-19	416 (87.39)	0.813	0.480-1.378	0.703	0.401-1.232		
Supporter							
None	129 (90.85)	1		1			
Peer	129 (87.76)	0.722	0.340-1.535	0.973	0.441-2.146		
Adults	326 (86.93)	0.670	0.352-1.277	0.839	0.430-1.637		
Nicotine dependence							
0-3	363 (86.22)	1		1			
4-10	232 (90.98)	1.611	0.968-2.685	1.143	0.651-2.006		
Alcohol consumption							
No	221 (84.67)	1		1			
Yes	369 (90.44)	1.712	1.069-2.744	1.397	0.837-2.333		
Number of smoking habits†							
0-1 habits	185 (84.09)	1		1			
2 habits	217 (87.85)	1.368	0.809-2.315	1.060	0.604-1.862		
>=3 habits	193 (92.34)	2.282	1.222-4.263	1.589	0.814-3.101		

Characteristics	Smoking relapse 595 (88.02)	Univariate model		Multivariate model*		Stepwise model	
		OR	95% CI	OR	95% CI	OR	95% CI
Self-efficacy							
0-2	129 (94.85)	1		1		1	
3-5	277 (91.71)	0.601	0.253-1.426	0.666	0.276-1.609	0.615	0.258-1.466
6-8	189 (79.41)	0.209	0.092-0.477	0.258	0.108-0.616	0.217	0.095-0.495
Kind of protocol [¥]							
Intervention 1	119 (85.61)	1		1			
Intervention 2	476 (88.64)	1.311	0.762-2.258	1.284	0.720-2.287		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

¥ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 13: Logistic regression model of relapse at 1-year follow-up among boy smokers (n=541)

Characteristics	Smoking relapse 478 (88.35)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Age							
13-16	146 (89.57)	1		1			
17-19	332 (87.83)	0.840	0.467-1.515	0.768	0.406-1.453		
Supporter							
None	114 (91.94)	1		1			
Peer	102 (89.47)	0.746	0.309-1.799	1.028	0.409-2.585		
Adult	254 (86.39)	0.557	0.269-1.153	0.681	0.322-1.439		
Nicotine dependence							
0-3	293 (87.20)	1		1			
4-10	185 (90.24)	1.358	0.774-2.380	0.983	0.527-1.834		
Alcohol consumption							
No	180 (86.12)	1		1			
Yes	294 (90.18)	1.480	0.866-2.529	1.251	0.698-2.242		
Number of smoking habits†							
0-1 habit	157 (84.86)	1		1			
2 habits	174 (88.78)	1.410	0.775-2.567	1.185	0.628-2.235		
>=3 habits	147 (91.88)	2.017	1.006-4.042	1.348	0.64-2.839		
Self-efficacy							
0-2	98 (95.15)	1		1		1	
3-5	221 (91.70)	0.564	0.206-1.545	0.616	0.22-1.725	0.589	0.214-1.625
6-8	159 (80.71)	0.213	0.813-0.561	0.249	0.09-0.691	0.226	0.086-0.595
Kind of protocol‡							
Intervention 1	94 (84.68)	1		1			
Intervention 2	384 (89.30)	1.510	0.828-2.752	1.421	0.749-2.696		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 14: Logistic regression model of relapse at 1-year follow-up among girl smokers (n=135)

Characteristics	Smoking relapse 117 (86.67)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Age							
13-16	33 (89.19)	1		1			
17-19	84 (85.71)	0.727	0.223-2.371	0.608	0.165-2.235		
Supporter							
None	15 (83.33)	1		1			
Peer	27 (81.82)	0.899	0.196-4.127	0.943	0.171-5.195		
Adult	72 (88.89)	1.600	0.387-6.620	1.949	0.399-9.519		
Nicotine dependence							
0-3	70 (82.35)	1		1			
4-10	47 (94.00)	3.357	0.921-12.239	2.284	0.535-9.748		
Alcohol consumption							
No	41 (78.85)	1		1			
Yes	75 (91.46)	2.875	1.035-7.982	2.833	0.772-10.397		
Number of smoking habits†							
0-1 habit	28 (80.00)	1		1			
2 habits	43 (84.31)	1.344	0.438-4.120	0.287	0.057-1.435		
>=3 habits	46 (93.88)	3.833	0.916-16.047	1.584	0.316-7.954		
Self-efficacy							
0-2	31 (93.94)	1		1		1	
3-5	56 (91.80)	0.723	0.132-3.946	0.705	0.118-4.202	0.684	0.125-3.738
6-8	30 (73.17)	0.176	0.040-0.861	0.153	0.025-0.942	0.170	0.035-0.834
Kind of protocol‡							
Intervention 1	25 (89.29)	1		1			
Intervention 2	92 (85.98)	0.736	0.197-2.744	1.064	0.25-4.531		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

3.3.4. Factors associated with smoking relapse by self-efficacy groups

Self-efficacy played an important role to predict smoking relapse, therefore, subgroup analysis by self-efficacy was performed.

- **Factors associated with smoking relapse at 30 days**

Table 14 shows predictors of smoking relapse at 30-day follow-up in lowest self-efficacy group by using logistic regression. Supporter was exclusive factors significantly associated with smoking relapse in all three models. In particular, adolescents having adult supporter such as parents or teachers were more likely to relapse than those did not have (in stepwise model: OR=5.675; 95%CI=1.871-17.214).

The association between related factors and smoking relapse in intermediate self-efficacy group by using logistic regression was seen in Table 15. Number of smoking habits and Quitline intervention were predictors of smoking relapse in univariate model. However, the effect of Quitline intervention was eliminated in multivariate and stepwise model. In general, among adolescents with intermediate self-efficacy score, likelihood of smoking relapse at 30-day follow-up tended to be associated with higher number of smoking habits.

Table 16 indicates significant association between alcohol drinking and smoking relapse at 30-day follow-up among adolescents in highest self-efficacy category. The risk of relapse was 2.4 times higher among those drinking alcohol, compared with others who did not.

Table 15: Logistic regression model of relapse at 30-day follow-up in lowest self-efficacy score (0-2) (n=136)

Characteristics	Smoking relapse 112 (82.35)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	86 (83.50)	1		1			
Girl	26 (78.79)	0.734	0.275-1.963	0.644	0.212-1.956		
Age							
13-16	24 (77.42)	1		1			
17-19	88 (83.81)	1.510	0.561-4.060	1.496	0.513-4.366		
Supporter							
None	21 (65.62)	1		1		1	
Peer	24 (77.42)	1.796	0.589-5.471	2.189	0.667-7.182	1.796	0.589-5.471
Adult	65 (91.55)	5.675	1.871-17.214	6.843	2.111-22.188	5.675	1.871-17.214
Nicotine dependence							
0-3	45 (81.82)	1		1			
4-10	67 (82.72)	1.063	0.434-2.603	1.541	0.576-4.12		
Alcohol consumption							
No	29 (80.56)	1		1			
Yes	82 (82.83)	1.164	0.438-3.092	1.185	0.398-3.529		
Number of smoking habits†							
0-1 habit	24 (85.71)	1		1			
2 habits	38 (80.85)	0.704	0.195-2.541	0.732	0.164-3.273		
>=3 habits	50 (81.97)	0.758	0.218-2.627	0.73	0.181-2.949		
Kind of protocol‡							
Intervention 1	22 (84.62)	1		1			
Intervention 2	90 (81.82)	0.818	0.254-2.637	1.202	0.322-4.485		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 16: Logistic regression model of relapse at 30-day follow-up in intermediate self-efficacy score (3-5) (n=302)

Characteristics	Smoking relapse 203 (67.22)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	160 (66.39)	1		1			
Girl	43 (70.49)	1.209	0.656-2.230	1.356	0.704-2.614		
Age							
13-16	61 (68.54)	1		1			
17-19	142 (66.67)	0.918	0.540-1.560	1.010	0.575-1.773		
Supporter							
None	56 (73.68)	1		1			
Peer	39 (72.22)	0.929	0.424-2.035	1.025	0.456-2.304		
Adult	104 (62.65)	0.599	0.329-1.091	0.600	0.322-1.116		
Nicotine dependence							
0-3	120 (66.30)	1		1			
4-10	83 (68.60)	1.110	0.679-1.817	1.124	0.663-1.906		
Alcohol consumption							
No	63 (62.38)	1		1			
Yes	137 (69.54)	1.377	0.832-2.280	1.181	0.687-2.029		
Number of smoking habits†							
0-1 habit	48 (57.14)	1		1		1	
2 habits	84 (70.59)	1.800	1.003-3.231	1.930	1.038-3.591	2.106	1.157-3.833
>=3 habits	71 (71.72)	1.902	1.028-3.517	1.790	0.92-3.484	2.171	1.160-4.063
Kind of protocol‡							
Intervention 1	37 (56.92)	1		1			
Intervention 2	166 (70.04)	1.769	1.006-3.110	1.563	0.851-2.871		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 17: Logistic regression model of relapse at 30-day follow-up in highest self-efficacy score (6-8) (n=238)

Characteristics	Smoking relapse 103 (43.28)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	85 (43.15)	1		1			
Girl	18 (43.90)	1.031	0.523-2.032	0.968	0.463-2.023		
Age							
13-16	33 (41.25)	1		1			
17-19	70 (44.30)	1.133	0.657-1.953	0.718	0.387-1.332		
Supporter							
None	19 (55.88)	1		1		1	
Peer	33 (53.23)	0.898	0.387-2.082	0.896	0.374-2.147	0.894	0.377-2.121
Adult	50 (36.23)	0.449	0.209-0.960	0.441	0.198-0.979	0.462	0.212-1.007
Nicotine dependence							
0-3	74 (40.00)	1		1			
4-10	29 (54.72)	1.813	0.979-3.355	1.419	0.726-2.774		
Alcohol consumption							
No	41 (33.06)	1		1		1	
Yes	62 (55.36)	2.510	1.481-4.256	2.434	1.367-4.335	2.379	1.387-4.080
Number of smoking habits†							
0-1 habit	42 (38.89)	1		1			
2 habits	34 (41.98)	1.137	0.632-2.044	0.898	0.478-1.688		
>=3 habits	27 (55.10)	1.929	0.974-3.818	1.889	0.903-3.954		
Kind of protocol‡							
Intervention 1	20 (41.67)	1		1			
Intervention 2	83 (43.68)	1.086	0.572-2.063	1.074	0.537-2.15		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

- **Factors associated with smoking relapse at 6 months**

Table 17, Table 18 and Table 19 show logistic regression model of relapse at 6-month follow-up in lowest, intermediate and highest self-efficacy score respectively. We did not find any significant association between concern factors and smoking relapse in all models.

Table 18: Logistic regression model of relapse at 6-month follow-up in lowest self-efficacy score (0-2) (n=136)

Characteristics	Smoking relapse 129 (93.94)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	98 (95.15)	1		1			
Girl	31 (93.94)	0.791	0.146-4.281	0.582	0.068-5.016		
Age							
13-16	30 (96.77)	1		1			
17-19	99 (94.29)	0.550	0.064-4.750	0.328	0.025-4.244		
Supporter							
None	27 (84.38)	1.000		1			
Peer	29 (93.55)	2.685	0.480-15.019	3.335	0.475-23.439		
Adult	71 (100.00)	-	-	-	-		
Nicotine dependence							
0-3	53 (96.36)	1		1			
4-10	76 (93.83)	0.574	0.107-3.068	0.497	0.063-3.913		
Alcohol consumption							
No	34 (94.44)	1		1			
Yes	94 (94.95)	1.106	0.205-5.970	1.572	0.189-13.095		
Number of smoking habits†							
0-1 habit	26 (92.86)	1		1			
2 habits	44 (93.62)	1.128	0.177-7.202	0.945	0.078-11.384		
>=3 habits	59 (96.72)	2.269	0.303-16.996	1.857	0.136-25.257		
Kind of protocol‡							
Intervention 1	24 (92.31)	1		1			
Intervention 2	105 (95.45)	1.750	0.320-9.567	3.648	0.372-35.782		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 19: Logistic regression model of relapse at 6-month follow-up in intermediate self-efficacy score (3-5) (n=302)

Characteristics	Smoking relapse 267 (88.41)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	212 (87.97)	1		1			
Girl	55 (90.16)	1.254	0.496-3.171	1.235	0.474-3.215		
Age							
13-16	84 (94.38)	1		1			
17-19	183 (85.92)	0.363	0.136-0.969	0.396	0.145-1.084		
Supporter							
None	70 (92.11)	1		1			
Peer	45 (83.33)	0.429	0.143-1.286	0.407	0.132-1.26		
Adult	147 (88.55)	0.663	0.254-1.734	0.660	0.248-1.76		
Nicotine dependence							
0-3	162 (89.50)	1		1			
4-10	105 (86.78)	0.770	0.379-1.564	0.865	0.405-1.845		
Alcohol consumption							
No	89 (88.12)	1		1			
Yes	174 (88.32)	1.020	0.485-2.145	1.219	0.549-2.71		
Number of smoking habits†							
0-1 habit	74 (88.10)	1		1			
2 habits	105 (88.24)	1.014	0.427-2.405	0.938	0.375-2.351		
>=3 habits	88 (88.89)	1.081	0.435-2.687	0.987	0.367-2.655		
Kind of protocol‡							
Intervention 1	54 (83.08)	1		1			
Intervention 2	213 (89.87)	1.808	0.834-3.919	1.808	0.802-4.077		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 20: Logistic regression model of relapse at 6-month follow-up in highest self-efficacy score (6-8) (n=238)

Characteristics	Smoking relapse 185 (77.73)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	155 (78.68)	1		1			
Girl	30 (73.17)	0.739	0.342-1.597	0.702	0.309-1.594		
Age							
13-16	62 (77.50)	1		1			
17-19	123 (77.85)	1.020	0.535-1.945	0.823	0.404-1.673		
Supporter							
None	29 (85.29)	1		1			
Peer	51 (82.26)	0.799	0.253-2.528	0.887	0.271-2.911		
Adult	101 (73.19)	0.471	0.170-1.301	0.529	0.186-1.51		
Nicotine dependence							
0-3	139 (75.14)	1		1			
4-10	46 (86.79)	2.175	0.918-5.151	1.758	0.707-4.373		
Alcohol consumption							
No	91 (73.39)	1		1			
Yes	94 (83.93)	1.894	0.996-3.601	1.744	0.869-3.501		
Number of smoking habits [†]							
0-1 habit	80 (74.07)	1		1			
2 habits	64 (79.01)	1.318	0.663-2.618	1.018	0.492-2.104		
>=3 habits	41 (83.67)	1.794	0.751-4.287	1.719	0.684-4.32		
Kind of protocol [‡]							
Intervention 1	34 (70.83)	1		1			
Intervention 2	151 (79.49)	1.594	0.780-3.259	1.580	0.735-3.394		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

- **Factors associated with smoking relapse at 1-year follow-up**

Table 20, Table 21 and Table 22 present factors associated with smoking relapse at 1-year follow-up by three self-efficacy levels. No factor was selected in stepwise model for smoking relapse among adolescents

In summary, by self-efficacy, we only found significant factors associated with smoking relapse at short-term of smoking abstinence. Having support was positive factor of smoking relapse among adolescent with lowest level of self-efficacy. Number of smoking habits and alcohol consumption played an important role of prediction of relapse in the intermediate and in the highest self-efficacy group, respectively.

Table 21: Logistic regression model of relapse at 1-year follow-up in lowest self-efficacy score (0-2) (n=136)

Characteristics	Smoking relapse 129 (93.94)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	98 (95.15)	1		1			
Girl	31 (93.94)	0.791	0.146-4.281	0.582	0.068-5.016		
Age							
13-16	30 (96.77)	1		1			
17-19	99 (94.29)	0.550	0.064-4.750	0.328	0.025-4.244		
Supporter							
None	27 (84.38)	1.000		1			
Peer	29 (93.55)	2.685	0.480-15.019	3.335	0.475-23.439		
Adult	71 (100.00)						
Nicotine dependence							
0-3	53 (96.36)	1		1			
4-10	76 (93.83)	0.574	0.107-3.068	0.497	0.063-3.913		
Alcohol consumption							
No	34 (94.44)	1		1			
Yes	94 (94.95)	1.106	0.205-5.970	1.572	0.189-13.095		
Number of smoking habits†							
0-1 habit	26 (92.86)	1		1			
2 habits	44 (93.62)	1.128	0.177-7.202	0.945	0.078-11.384		
>=3 habits	59 (96.72)	2.269	0.303-16.996	1.857	0.136-25.257		
Kind of protocol‡							
Intervention 1	24 (92.31)	1		1			
Intervention 2	105 (95.45)	1.750	0.320-9.567	3.648	0.372-35.782		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 22: Logistic regression model of relapse at 1-year follow-up in intermediate self-efficacy score (3-5) (n=302)

Characteristics	Smoking relapse 277 (91.72)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	221 (91.70)	1		1			
Girl	56 (91.80)	1.014	0.364-2.819	1.051	0.362-3.054		
Age							
13-16	86 (96.63)	1		1			
17-19	191 (89.67)	0.303	0.088-1.039	0.314	0.089-1.111		
Supporter							
None	73 (96.05)	1		1			
Peer	47 (87.04)	0.276	0.068-1.120	0.248	0.059-1.045		
Adult	152 (91.57)	0.446	0.124-1.601	0.474	0.130-1.732		
Nicotine dependence							
0-3	168 (92.82)	1		1			
4-10	109 (90.08)	0.703	0.309-1.597	0.773	0.319-1.872		
Alcohol consumption							
No	93 (92.08)	1		1			
Yes	180 (91.37)	0.911	0.379-2.189	1.057	0.413-2.704		
Number of smoking habits†							
0-1 habit	77 (91.67)	1		1			
2 habits	107 (89.92)	0.811	0.305-2.154	0.802	0.284-2.266		
>=3 habits	93 (93.94)	1.409	0.455-4.368	1.499	0.443-5.072		
Kind of protocol‡							
Intervention 1	58 (89.23)	1		1			
Intervention 2	219 (92.41)	1.468	0.585-3.684	1.379	0.525-3.622		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main program; Intervention 2: using only main program without pre-program;

Table 23: Logistic regression model of relapse at 1-year follow-up in highest self-efficacy score (6-8) (n=238)

Characteristics	Smoking relapse 189 (79.41)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	159 (80.71)	1		1			
Girl	30 (73.17)	0.652	0.230-1.417	0.618	0.271-1.409		
Age							
13-16	63 (78.75)	1		1			
17-19	126 (79.75)	1.063	0.548-2.059	0.912	0.442-1.882		
Supporter							
None	29 (85.29)	1		1			
Peer	53 (85.48)	1.015	0.311-3.315	1.189	0.350-4.042		
Adult	103 (74.64)	0.507	0.182-1.412	0.582	0.204-1.659		
Nicotine dependence							
0-3	142 (76.76)	1		1			
4-10	47 (88.68)	2.372	0.949-5.926	1.808	0.693-4.717		
Alcohol consumption							
No	94 (75.81)	1		1			
Yes	95 (84.82)	1.783	0.922-3.450	1.536	0.751-3.141		
Number of smoking habits†							
0-1 habit	82 (75.93)	1		1			
2 habits	66 (81.48)	1.395	0.684-2.847	1.078	0.508-2.287		
>=3 habits	41 (83.67)	1.625	0.676-3.905	1.61	0.637-4.073		
Kind of protocol‡							
Intervention 1	37 (77.08)	1		1			
Intervention 2	152 (80.00)	1.189	0.555-2.546	1.131	0.500-2.558		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

3.2.5. Factors associated with smoking relapse by nicotine dependence group

Nicotine dependence was a well-known factor statistically significant related to smoking relapse. Therefore, in this study, to eliminate its effect, we do logistic analysis to identify predictors of smoking relapse by subgroup analysis of nicotine dependence. We separated into 2 group, lower nicotine dependence scored from 0 to 3 and higher group scored from 4 to 10.

- **Factors associated with smoking relapse at 30-day follow-up.**

Table 23 and Table 24 show the association between concern factors and relapse outcome at 30-day by nicotine dependence levels. In both tables, self-efficacy was a significant factor which correlated to smoking relapse. Specially, there was significant association between alcohol consumption and smoking relapse in lower nicotine dependence group only (in stepwise model: OR=1.981; 95%CI=1.302-3.014).

Table 24: Logistic regression model of relapse at 30-day follow-up in lower nicotine dependence group (n=421)

Characteristics	Smoking relapse 239 (56.77)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	191 (56.85)	1		1			
Girl	48 (56.47)	0.985	0.609-1.592	0.938	0.548-1.606		
Age							
13-16	79 (56.03)	1		1			
17-19	160 (57.14)	1.046	0.696-1.574	0.756	0.472-1.211		
Supporter							
None	55 (67.07)	1		1			
Peer	56 (62.22)	0.809	0.432-1.514	1.026	0.521-2.022		
Adult	122 (50.83)	0.508	0.300-0.858	0.597	0.338-1.054		
Alcohol consumption							
No	88 (45.36)	1		1		1	
Yes	148 (66.97)	2.442	1.640-3.636	1.926	1.234-3.005	1.981	1.302-3.014
Number of smoking habits†							
0-1 habit	76 (48.10)	1		1			
2 habits	85 (57.05)	1.433	0.914-2.248	1.142	0.694-1.879		
>=3 habits	78 (68.42)	2.338	1.413-3.867	1.727	0.98-3.041		
Self-efficacy							
0-2	45 (81.81)	1		1		1	
3-5	120 (66.30)	0.437	0.206-0.927	0.461	0.211-1.004	0.474	0.221-1.017
6-8	74 (40.00)	0.148	0.070-0.312	0.186	0.085-0.404	0.186	0.087-0.398
Kind of protocol‡							
Intervention 1	41 (48.81)	1		1			
Intervention 2	198 (58.75)	1.494	0.925-2.413	1.621	0.94-2.796		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 25: Logistic regression model of relapse at 30-day follow-up in higher nicotine dependence group (n=255)

Characteristics	Smoking relapse 179 (70.20)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	140 (68.29)	1		1			
Girl	39 (78.00)	1.646	0.793-3.419	1.302	0.605-2.802		
Age							
13-16	39 (66.10)	1		1			
17-19	140 (71.43)	1.282	0.688-2.388	1.286	0.666-2.483		
Supporter							
None	41 (68.33)	1		1			
Peer	40 (70.18)	1.090	0.497-2.393	1.259	0.547-2.897		
Adult	97 (71.85)	1.183	0.611-2.290	1.313	0.655-2.631		
Alcohol consumption							
No	45 (67.16)	1		1			
Yes	133 (71.12)	1.204	0.661-2.194	1.094	0.582-2.058		
Number of smoking habits†							
0-1 habit	38 (61.29)	1		1			
2 habits	71 (72.45)	1.661	0.844-3.267	1.518	0.736-3.132		
>=3 habits	70 (73.68)	1.768	0.891-3.509	1.386	0.662-2.900		
Self-efficacy							
0-2	67 (82.72)	1		1		1	
3-5	83 (68.60)	0.456	0.228-0.912	0.464	0.228-0.940	0.463	0.231-0.928
6-8	29 (54.72)	0.252	0.115-0.556	0.272	0.119-0.626	0.254	0.115-0.565
Kind of protocol‡							
Intervention 1	38 (69.09)	1		1			
Intervention 2	141 (70.20)	1.069	0.559-2.043	0.953	0.475-1.913		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

- **Factors associated with smoking relapse at 6-month follow-up**

Table 25 shows the factors associated with smoking relapse at 6-month follow-up in lower nicotine dependence group. In univariate model, drinking alcohol, having higher number of smoking habits and having lower level of self-efficacy increased the likelihood of smoking relapse. Interestingly, in the multivariate, the risk of smoking relapse was lesser among adolescent who aged 17-19 years (OR=0.526, 95%CI=0.278-0.995), compared to those was 13-16 years old. Two significant variables- self-efficacy and Quitline intervention was included in final model by using stepwise regression. In particular, adolescents who used main program without pre-program were more likely to relapse than others who used both pre-program and main program (OR= 1.984; 95%CI=1.053-3.738).

On the other hand, we did not see any significant association with smoking relapse in higher nicotine dependence group (table 26).

Table 26: Logistic regression model of relapse at 6-month follow-up in lower nicotine dependence group (n=421)

Characteristics	Smoking relapse 354 (84.09)	Univariate model		Multivariate model*		Stepwise model	
		OR	95% CI	OR	95% CI	OR	95% CI
Gender							
Boy	284 (84.52)	1		1			
Girl	70 (82.35)	0.854	0.455-1.606	0.721	0.365-1.427		
Age							
13-16	123 (87.23)	1		1			
17-19	231 (82.50)	0.690	0.385-1.236	0.526	0.278-0.995		
Supporter							
None	72 (87.80)	1		1			
Peer	75 (83.33)	0.694	0.293-1.646	0.915	0.365-2.293		
Adult	198 (82.50)	0.655	0.312-1.373	0.797	0.364-1.747		
Alcohol consumption							
No	154 (79.38)	1		1			
Yes	196 (88.69)	2.036	1.184-3.503	1.795	0.989-3.259		
Number of smoking habits†							
0-1 habit	124 (78.48)	1		1			
2 habits	126 (84.56)	1.502	0.837-2.695	1.068	0.568-2.009		
>=3 habits	104 (91.23)	2.852	1.345-6.047	2.086	0.933-4.667		
Self-efficacy							
0-2	53 (96.36)	1		1		1	
3-5	162 (89.50)	0.322	0.073-1.427	0.338	0.075-1.528	0.322	0.072-1.435
6-8	139 (75.14)	0.114	0.027-0.486	0.139	0.032-0.608	0.118	0.028-0.507
Kind of protocol‡							
Intervention 1	65 (77.38)	1		1		1	
Intervention 2	289 (85.76)	1.760	0.970-3.192	1.902	0.994-3.637	1.984	1.053-3.738

OR= Odds ratio, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main program; Intervention 2: using only main program without pre-program;

Table 27: Logistic regression model of relapse at 6-month follow-up in higher nicotine dependence group (n=255)

Characteristics	Smoking relapse 227 (89.02)	Univariate model		Multivariate model*		Stepwise model	
		OR	95% CI	OR	95% CI	OR	95% CI
Gender							
Boy	181 (88.29)	1		1			
Girl	46 (92.00)	1.525	0.504-4.613	1.353	0.434-4.224		
Age							
13-16	53 (89.83)			1			
17-19	174 (88.78)	0.895	0.345-2.324	0.961	0.357-2.592		
Supporter							
None	54 (90.00)	1		1			
Peer	50 (87.72)	0.794	0.250-2.522	0.772	0.233-2.558		
Adult	121 (89.63)	0.960	0.350-2.633	1.034	0.368-2.909		
Alcohol consumption							
No	60 (89.55)	1		1			
Yes	166 (88.77)	0.922	0.373-2.279	0.975	0.381-2.490		
Number of smoking habits†							
0-1 habit	56 (90.32)	1		1			
2 habits	87 (88.78)	0.847	0.297-2.421	0.803	0.267-2.410		
>=3 habits	84 (88.42)	0.818	0.286-2.340	0.677	0.223-2.054		
Self-efficacy							
0-2	76 (93.83)	1		1			
3-5	105 (86.78)	0.432	0.152-1.230	0.441	0.152-1.286		
6-8	46 (86.79)	0.432	0.130-1.442	0.419	0.119-1.480		
Kind of protocol‡							
Intervention 1	47 (85.45)	1		1			
Intervention 2	180 (90.00)	1.532	0.635-3.695	1.552	0.607-3.968		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

- **Factors associated with smoking relapse at 1-year follow-up**

Table 27 presents logistic regression model of relapse at 1-year follow-up in lower nicotine dependence group. The higher number of smoking habits and lower self-efficacy were also significantly higher risk of smoking relapse. The relationship between alcohol drinking and cessation outcome was shown in univariate model (OR=1.922; 95%CI=1.081-3.417), but not in multivariate model. The final variable in the stepwise model is only self-efficacy (6-8: OR=0.134; 95%CI=0.031-0.574). Differently, no factor showed significant association with smoking relapse at 1-year follow-up in higher dependence category (table 28).

In summary of lower nicotine dependence group, alcohol consumption and self-efficacy were significant predictors related to smoking relapse at 30-day follow-up. Specially, at 6-month follow-up, using both pre-program and main program significantly decreased the likelihood of relapse. However, only self-efficacy was a determinant of smoking relapse at 1-year. Regarding higher nicotine dependence group, self-efficacy is exclusive factors associated with relapse within 30 days. We could not find any significant factors of smoking relapse at 6-month and 1-year.

Table 28: Logistic regression model of relapse at 1-year follow-up in lower nicotine dependence group (n=421)

Characteristics	Smoking relapse 363 (86.22)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	293 (87.20)	1		1			
Girl	70 (82.35)	0.685	0.360-1.303	0.544	0.268-1.102		
Age							
13-16	125 (88.65)	1		1			
17-19	238 (85.00)	0.725	0.392-1.342	0.571	0.291-1.121		
Supporter							
None	75 (91.46)	1		1			
Peer	79 (87.78)	0.67	0.247-1.820	0.995	0.343-2.883		
Adult	200 (83.33)	0.467	0.200-1.087	0.596	0.245-1.451		
Alcohol consumption							
No	160 (82.47)	1		1			
Yes	199 (90.05)	1.922	1.081-3.417	1.503	0.795-2.841		
Number of smoking habits†							
0-1 habit	127 (80.38)	1		1			
2 habits	130 (87.25)	1.670	0.897-3.108	1.18	0.602-2.312		
>=3 habits	106 (92.98)	3.234	1.426-7.335	2.578	1.07-6.21		
Self-efficacy							
0-2	53 (96.36)	1		1		1	
3-5	168 (92.82)	0.488	0.107-2.231	0.481	0.103-2.245	0.483	0.105-2.211
6-8	142 (76.76)	0.125	0.029-0.533	0.146	0.033-0.646	0.134	0.031-0.574
Kind of protocol‡							
Intervention 1	70 (83.33)	1		1			
Intervention 2	293 (86.94)	1.332	0.691-2.565	1.384	0.675-2.837		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

Table 29: Logistic regression model of relapse at 1-year follow-up in higher nicotine dependence group (n=255)

Characteristics	Smoking relapse 232 (90.98)	Univariate model		Multivariate model*		Stepwise model	
		OR	95%CI	OR	95%CI	OR	95%CI
Gender							
Boy	185 (90.24)	1		1			
Girl	47 (94.00)	1.694	0.483-5.941	1.521	0.418-5.535		
Age							
13-16	54 (91.53)	1		1			
17-19	178 (90.82)	0.916	0.325-2.582	0.928	0.314-2.738		
Supporter							
None	54 (90.00)	1		1			
Peer	50 (87.72)	0.794	0.250-2.522	0.759	0.228-2.531		
Adult	126 (93.33)	1.556	0.527-4.585	1.596	0.529-4.822		
Alcohol consumption							
No	61 (91.04)	1		1			
Yes	170 (90.91)	0.984	0.371-2.609	1.005	0.363-2.779		
Number of smoking habits†							
0-1 habit	58 (93.55)	1		1			
2 habits	87 (88.78)	0.545	0.166-1.796	0.527	0.153-1.823		
>=3 habits	87 (91.58)	0.750	0.216-2.606	0.646	0.175-2.383		
Self-efficacy							
0-2	76 (93.83)	1		1			
3-5	109 (90.08)	0.598	0.202-1.766	0.587	0.191-1.801		
6-8	47 (88.68)	0.515	0.149-1.783	0.524	0.140-1.966		
Kind of protocol‡							
Intervention 1	49 (89.09)	1		1			
Intervention 2	183 (91.50)	1.318	0.493-3.521	1.459	0.507-4.197		

OR= Odds ratios, CI=confidence intervals

* Adjusted for all other variables in table.

† Smoking habits: smoking after meal, smoking when drinking coffee or alcohol, temptation of environments, smoking when having emotions or feelings, smoking when being alone, smoking relating some activities or others.

‡ Kind of protocol: Intervention 1: using both pre-program and main-program; Intervention 2: using only main program without pre-program;

4. Discussion

In this study, we evaluated cessation outcome of Quitline service. In general, relapse rate at 30 days, 6 months and 1 year were 61.83%, 85.95% and 88.02% respectively, which are consistent to results of a previous systematic review. Particularly, relapse rate within 1 year following the longest attempt ranged from 88 to 95% [11].

Our main purpose of this study was to identify potential factors of smoking relapse in Quitline service among Korean adolescents. The study revealed the main findings that using both pre-and main program significantly contributed to successful cessation among youth after adjusting appropriate factors. Moreover, these programs further achieved a better effectiveness among adolescent who had lower self-efficacy, although there was no statistical significance. In consistent with previous studies, lower self-efficacy, alcohol consumption, higher nicotine dependence, and higher number of smoking habits played an important role as positive predictors of initial relapse regardless of which intervention was applied. Additionally, consistent effects of these factors on smoking relapse were seen in subgroup analysis.

The correlation between socio-demographic factors and smoking cessation was contradictory in the previous finding of literature. Girls are less likely to relapse than boys [19], while other studies show the opposite correlation [16, 20]. Regarding age, older adolescents tended to relapse easily than younger ones [20,

23, 28]. However, our study did not find any socio-demographic factors significantly associated with smoking relapse, which is consistent with previous findings [12, 29, 40-42].

After using the resemble protocol with adults, Quitline services offered a specialized protocol for adolescent and additional motivation intervention (pre-program) to assist adolescent quit smoking with better cessation. Herein, we compared smoking cessation outcome in using main-program with pre-program (intervention 1) and using only main program (intervention 2). The results show the fact that successful quit rate among adolescent who used both pre-program and main program was higher at any follow-up time points. However, among girls, at long-term smoking abstinence, success rates at 1-year follow-up were quite similar in both interventions. In the complex context, multiple logistic regression was used to see the final effect of Quitline intervention and cessation outcome. Although we cannot clarify quit motivations' effect on final outcome, the statistical significance of Quitline intervention and smoking relapse only was seen at 6-month follow-up. However, we could not see statistically significant results at 1-year. In a subgroup analysis of self-confidence, we can see the odds of using only main program were highest in the lowest self-efficacy score group and were lowest in the highest self-efficacy score group. In other words, there was the higher effectiveness of using both main program with pre-program in lower score of self-efficacy, compared to using main program only (but they did not show statistical significance).

Strong evidence from several past studies reinforce the fact that self-efficacy is one of the main factors correlating with smoking cessation outcome [43, 44], and was also found among adolescents [18, 25]. The result indicates that adolescents having higher self-efficacy level were less likely to relapse, and its effect maintained in all logistic regression models and in both sexes in this study. At long-term smoking abstinence, self-efficacy is a unique factor significantly affecting success in quitting smoking. In particular among girls, only self-efficacy was a determinant of preventing smoking relapse, whereas there was no statistically significant relationship between other factors with cessation outcome. Therefore, ameliorating self-efficacy for adolescents during behavioral counselling has a leading role in the quitting process and it should be continuously strengthened along maintenance of long-term smoking cessation.

In our study, we found that alcohol drinking was associated with smoking relapse among adolescents. It is similar to previous studies, which reported that teenagers drinking alcohol had more risk of relapse [16, 19-21]. Interestingly, in this study, a significant association between alcohol consumption and smoking cessation outcome was found at 30-day follow-up. It can be explained the fact that drinking alcohol can indirectly reflect social relationships/behaviors, so that it can further facilitate environmental pressure or social temptation triggering adolescents smoke. Therefore, evading environmental temptation in the social situation is important to maintain smoking cessation abstinence, especially among boys because of their high drinking prevalence.

Heavy dependence on nicotine was the chief obstacle in the path of successful smoking cessation. The results from one prospective study in the U.S. showed that each unit increase in nicotine dependence score, the odds of quitting were 23% lower [12], and there are consistent results in other studies [13-18]. In our study, the result shows that a significant association was observed in the univariate model, but it was eliminated in multivariate logistic regression model. It may be due to the fact that adolescents have low dependence on nicotine because of short duration of tobacco using.

When we further analyzed by subgroup of adolescents with self-efficacy category, despite having quit supporter makes smokers more likely to succeed in maintaining smoking abstinence [40, 45, 46], our findings show opposite results among adolescents with low self-efficacy. In South Korea, parents usually tend to impose their strong parental authority to make their children quit smoking. It may exert pressure or negative attitude (e.g. critical thinking) on adolescents' smoking behaviors, leading them to contest and/or protest parental restriction or disapproval to demonstrate their independent-mindedness. This does not seem to bring beneficial effects on successful cessation. On the other hand, negative support also can be caused by peer support such as over-criticality and over-emotionality. In addition, the pressure on losing friendship due to quitting can lead to relapse [47]. For these reasons, it is very important to boost social support with supportive behaviors instead of negative support to maintain sustained motivation of quitting.

Nicotine addiction is caused by many factors, one of them is that smokers learn from behaviors of nicotine use and make those behaviors part of their lifestyle, which is called smoking triggers. These included smoking after meal, smoking when drinking coffee or alcohol, temptation of environments (e.g. when seeing others smoking), smoking when having emotions or feelings (e.g. stressed, tired), etc. Therefore, smokers must be badly suffered from harsh urges and cravings to smoke before achieving long-term smoking abstinence. Noticeably, our study is one of the first studies which identified the relationship between such smoking habits and smoking cessation outcome. The present result shows that the higher the number of smoking habits adolescent had, the higher the risk of smoking relapse. However, we cannot see its significant effect in multivariate model. The finding supports the fact that avoiding and defusing urge to smoke as an important component of Quitline, which plays an important role to help adolescents conquer smoking cessation.

This is one of the first longitudinal follow up studies identifying factors associated with smoking cessation among adolescent smokers, which supplied more valuable evidence in context having a huge knowledgeable gap in this area in Asia. Throughout this study, we identified crucial issues to consolidate, adjust appropriate cessation programs or interventions for adolescent smokers. However, there were several limitations in this study. First, smoking outcome was based on smokers' self-assessment, it was not confirmed by any objective method. Second, we defined smoking relapse as adolescent smokers who relapsed within 1-year

follow up, in other words, adolescents who relapsed after 1 year were not considered. Third, in the study framework, we only examined the first quit attempt in Quitline service, subsequent multiple quit tries were not considered. Fourth, selection bias existed in this study because we could not do randomly assigned each adolescent smoker into Quitline interventions. Consequently, there is significant difference in motivation between two intervention groups. Unfortunately, we could not do subgroup analysis by quit motivation because small number of participants, who engaged in intervention 2, did not have motivation to quit. However, we tried to do subgroup analysis by self-efficacy and nicotine dependence. Finally, school and family environments are one of the most important factors which are strongly influent to adolescent, as reviews were shown above. However, our study did not investigate in detail these factors such as parental smokers, parental disapproval for smoking, number of peer smokers. Therefore, further research is needed to fully investigate about the relationship between these factors and cessation outcome.

5. Conclusion

This study highlights significant impact of Quiline program as well as motivation enhancement intervention (herein is Pre-program) in success of smoking cessation for adolescents. Therefore, it might be promising approach that can be applied in youth-focused intervention to achieve successful cessation. Additionally, ameliorating self-efficacy and evading environmental temptation (e.g. alcohol consumption) has a leading role in the quitting process and it should be continuously strengthened along maintenance of long-term smoking cessation.

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ACKNOWLEDGEMENT

In the implementation process of master thesis and master degree achievement, I am extremely grateful to all special people who accompanied and supported me during 2 years in South Korea.

First of all, I would like to gratefully thank my supervisor, Professor Min Kyung Lim, who carefully guide, and help me broaden my horizon along during 2 years in NCC-GCSP. From bottom of my heart, I would like to express my profound gratitude for everything you did for me, and I will never forget these precious days. Especially, I really do appreciate for patiently reviewing, and giving precise suggestions and valuable recommendations for this research in your busy schedule. I also heartily thank committee members, Professor Yoon Hee Kim and Professor Yu Jin Paek, for helpful advice and great help to improve this study.

Special thanks to my sister, Jinju Park and Eunjung Park, who overwhelmingly supported and generously helped me so that I can complete this thesis.

I also would like to express my appreciations to my great labmates and my friends in GCSP and my sister Goun Lim in Korean Quitline office, those always beside, encourage and give me valuable advice in school as well as in daily life. Thank my best friend Ngoc Phuong (Sophia) for being my company, I always feel lucky and thankful for having you in my life.

Last but not least, I am truly grateful to my family for unconditional love, spiritual support and facilitating for me to pursue and complete master degree in NCC-GCSP.

Thank you.