

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

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for the Master's Degree of Public Health**

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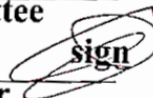
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ABSTRACT

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.

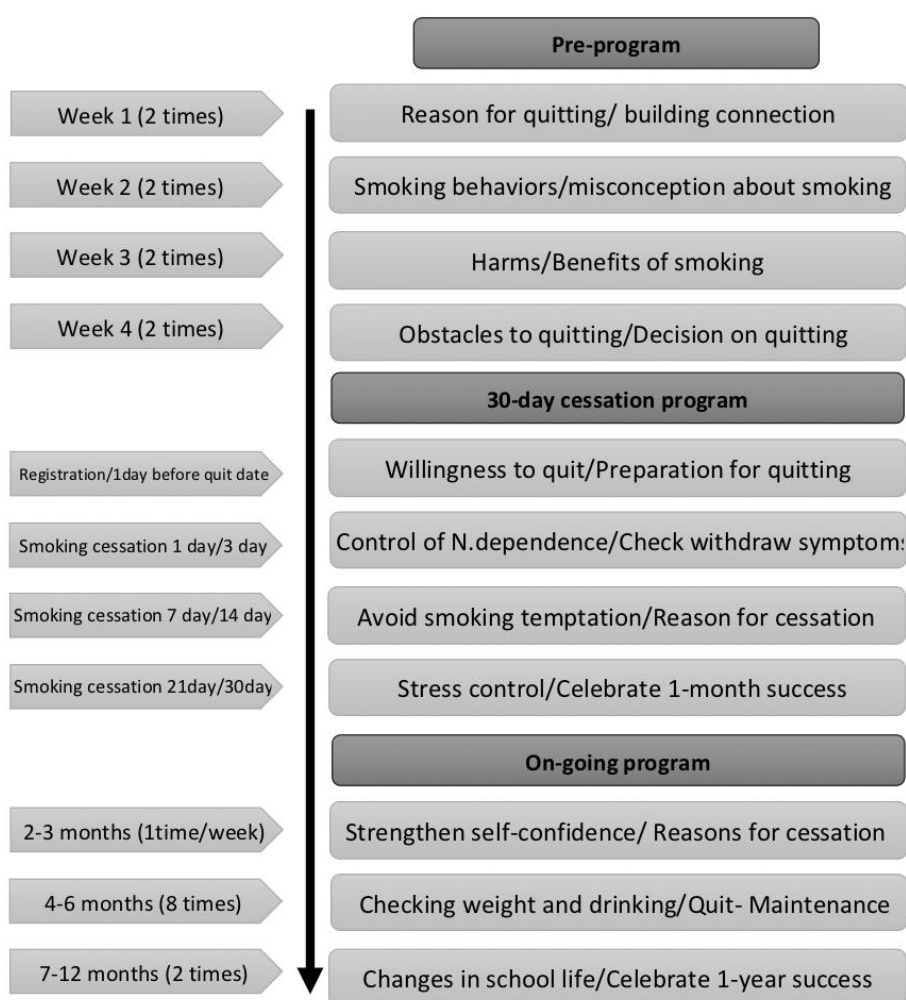


Figure 1: Summary of pre-program and main-program protocol in Quitline

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/advice 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 assignment, 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.

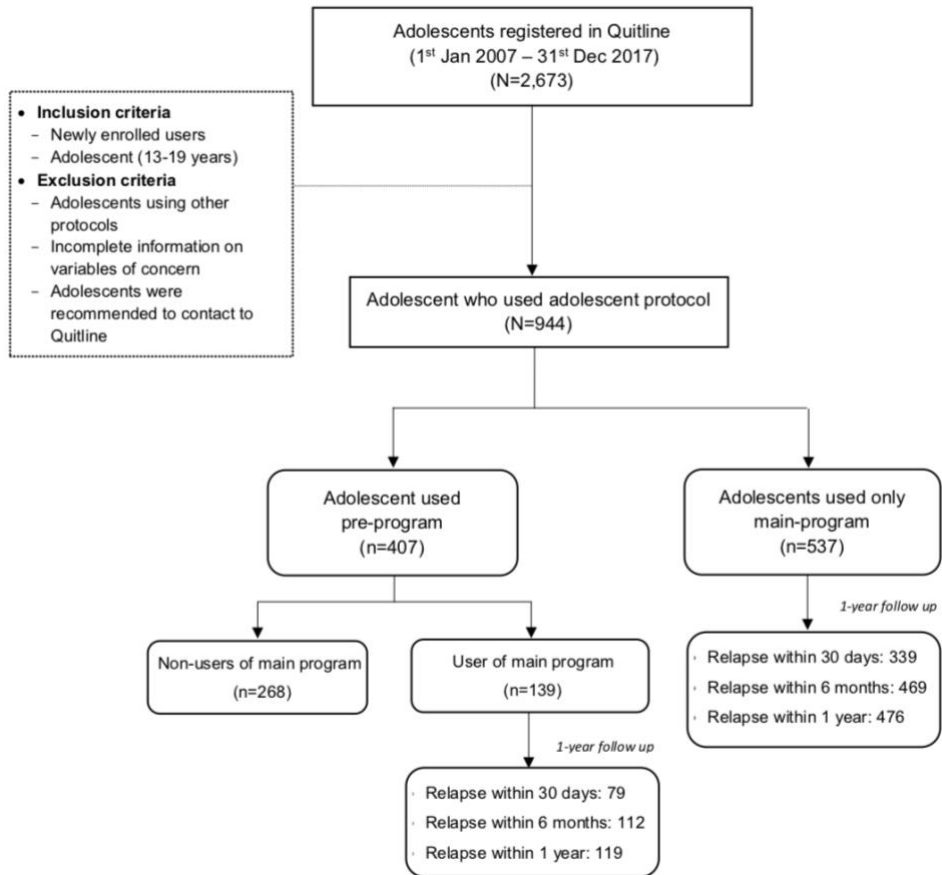


Figure 2: A flowchart of study population

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.

BIBLIOGRAPHY

1. WHO, *Reprot on the Global Tobacco Epidemic* 2017.
2. WHO, *Report on the Global Tobacco Epidemic* 2008.
3. WHO, *Tobacco breaks heart, choose health, not tobacco*. 2018.
4. WHO. *Tobacco*. 2018 09/03/2018 [cited 2018 25/06]; Available from: <http://www.who.int/en/news-room/fact-sheets/detail/tobacco>.
5. Society, T.A.C., *The Tobacco Atlas*. 2018.
6. WHO, *Global reprot of trends in prevalence of tobacco smoking 2000-2025*. 2018.
7. Society, T.A.C. *The Tobacco Atlas, Youth*. [cited 2018 2-7]; Available from: <https://tobaccoatlas.org/topic/youth/>.
8. WHO. *Health effects of smoking among young people*. 2018 [cited 2018 03-07]; Available from: http://www.who.int/tobacco/research/youth/health_effects/en/.
9. Services., U.D.o.H.a.H., *Preventing Tobacco Use among Young people, A report of the Surgeon General*. 1994.
10. Sussman, S. and P. Sun, *Youth tobacco use cessation: 2008 update*. Tobacco induced diseases, 2009. **5**(1): p. 3-3.
11. Bancej, C., et al., *Smoking cessation attempts among adolescent smokers: a systematic review of prevalence studies*. Tobacco Control, 2007. **16**(6): p. e8-e8.
12. Walker, J.F. and P.D. Loprinzi, *Longitudinal Examination of Predictors of Smoking Cessation in a National Sample of U.S. Adolescent and Young Adult Smokers*. Nicotine & Tobacco Research, 2014. **16**(6): p. 820-827.
13. Heikkinen, A.M., et al., *Key factors in smoking cessation intervention among 15-16-year-olds*. Behav Med, 2009. **35**(3): p. 93-9.
14. Rose, J.S., et al., *Prospective predictors of quit attempts and smoking cessation in young adults*. Health Psychol, 1996. **15**(4): p. 261-8.
15. Horn, K., et al., *Adolescent nicotine dependence and smoking cessation outcomes*. Addictive Behaviors, 2003. **28**(4): p. 769-776.
16. Haug, S., M.P. Schaub, and H. Schmid, *Predictors of adolescent smoking cessation and smoking reduction*. Patient Educ Couns, 2014. **95**(3): p. 378-83.
17. El Mhamdi, S., et al., *Predictors of smoking relapse in a cohort of adolescents and young adults in Monastir (Tunisia)*. Tobacco Induced Diseases, 2013. **11**(1): p. 12-12.

18. Mercincavage, M., et al., *Time to First Cigarette Predicts Cessation Outcomes in Adolescent Smokers*. Nicotine & Tobacco Research, 2013. **15**(12): p. 1996-2004.
19. Stanton, W., J. Baade P Fau - Moffatt, and J. Moffatt, *Predictors of smoking cessation processes among secondary school students*. 2006(1082-6084 (Print)).
20. Ariza-Cardenal, C. and M. Nebot-Adell, *Factors associated with smoking progression among Spanish adolescents*. Health Educ Res, 2002. **17**(6): p. 750-60.
21. Chang, F.C., et al., *Social influences and self-efficacy as predictors of youth smoking initiation and cessation: a 3-year longitudinal study of vocational high school students in Taiwan*. Addiction, 2006. **101**(11): p. 1645-55.
22. Tsuji, M., et al., *[Factors associated with successful smoking cessation among adolescent smokers undergoing a smoking cessation program involving nicotine replacement therapy]*. Nihon Koshu Eisei Zasshi, 2007. **54**(5): p. 304-13.
23. Milena D. Anatchkova, C.A.R., Joseph S. Rossi *Factors Associated with Smoking Cessation and Risk of Smoking Initiation in Bulgarian Youth* Californian Journal of Health Promotion, 2006. **4**(2): p. 1-12.
24. Zhu, S.H., et al., *Predictors of smoking cessation in U.S. adolescents*. Am J Prev Med, 1999. **16**(3): p. 202-7.
25. Kim, S.R., et al., *Smoking Cessation Failure Among Korean Adolescents*. J Sch Nurs, 2016. **32**(3): p. 155-63.
26. Bricker, J.B., et al., *Parents who quit smoking and their adult children's smoking cessation: a 20-year follow-up study*. Addiction (Abingdon, England), 2009. **104**(6): p. 1036-1042.
27. Sargent, J.D., L.A. Mott, and M. Stevens, *Predictors of smoking cessation in adolescents*. Archives of Pediatrics & Adolescent Medicine, 1998. **152**(4): p. 388-393.
28. Van Zundert, R.M., R.C.M.E. Kuntsche E Fau - Engels, and R.C. Engels, *In the heat of the moment: alcohol consumption and smoking lapse and relapse among adolescents who have quit smoking*. 2012(1879-0046 (Electronic)).
29. Cengelli, S., et al., *A systematic review of longitudinal population-based studies on the predictors of smoking cessation in adolescent and young adult smokers*. Tobacco Control, 2011.

30. Ravinder Gabbie, A.B., Emily DiSante, Robert Schwartz, *Smoking Cessation Interventions for Youth: A Review of the Literature*. 2015, The Ontario Tobacco Research Unit.
31. Micah H. Milton, M.C.O.M., Sue Lin Yee, MA, MPH Cathy Backinger, PhD Ann M. Malarcher, PhD Corinne G. Husten, MD, MPH, *Youth Tobacco Cessation: A Guide for making informed decisions*. 2004, Centers for disease control and prevention (CDC).
32. Fanshawe, T.R., et al., *Tobacco cessation interventions for young people*. Cochrane Database of Systematic Reviews, 2017(11).
33. Harvey, J. and N. Chadi, *Strategies to promote smoking cessation among adolescents*. Paediatrics & child health, 2016. **21**(4): p. 201-208.
34. Shruthi P. S., N.B.S., Punith Shetty, Krishna Chaitanya, Naveen Khargekar*, *Role of social support in tobacco cessation*. International Journal of Community Medicine and Public Health, 2017. **4**(11): p. 3942-3947.
35. Bilgiç, N. and T. Günay, *Evaluation of effectiveness of peer education on smoking behavior among high school students*. Saudi medical journal, 2018. **39**(1): p. 74-80.
36. Abdi, F. and M. Simbar, *The Peer Education Approach in Adolescents- Narrative Review Article*. Iranian journal of public health, 2013. **42**(11): p. 1200-1206.
37. Myung, S.-K., et al., *An observational study of the Korean proactive quitline service for smoking cessation and relapse prevention*. Public health reports (Washington, D.C. : 1974), 2011. **126**(4): p. 583-590.
38. Heatherton, T.F., et al., *The Fagerström test for nicotine dependence: a revision of the Fagerstrom Tolerance Questionnaire*. British journal of addiction, 1991. **86**(9): p. 1119-1127.
39. Shin, S.R., *Self efficacy scale: Reliability and validity test*. Journal of Korean Academy of Adult Nursing, 1999. **11**(4): p. 663-672.
40. Ellickson, P.L., D.J. Tucker Js Fau - Klein, and D.J. Klein, *Sex differences in predictors of adolescent smoking cessation*. 2001(0278-6133 (Print)).
41. Ellickson, P.L., D.J. McGuigan Ka Fau - Klein, and D.J. Klein, *Predictors of late-onset smoking and cessation over 10 years*. 2001(1054-139X (Print)).
42. Tucker, J.S., D.J. Ellickson Pl Fau - Klein, and D.J. Klein, *Smoking cessation during the transition from adolescence to young adulthood*. 2001(1462-2203 (Print)).

43. Gwaltney, C.J., et al., *Self-efficacy and smoking cessation: a meta-analysis*. Psychology of addictive behaviors : journal of the Society of Psychologists in Addictive Behaviors, 2009. **23**(1): p. 56-66.
44. Elshatarat, R.A., et al., *Self-efficacy in treating tobacco use: A review article*. Proceedings of Singapore Healthcare, 2016. **25**(4): p. 243-248.
45. Coleman-Wallace, D., et al., *Evaluation of developmentally appropriate programs for adolescent tobacco cessation*. J Sch Health, 1999. **69**(8): p. 314-9.
46. Carlson, L.E., et al., *The addition of social support to a community-based large-group behavioral smoking cessation intervention: improved cessation rates and gender differences*. 2002(0306-4603 (Print)).
47. Lim, M.K., et al., *Role of quit supporters and other factors associated with smoking abstinence in adolescent smokers: a prospective study on Quitline users in the Republic of Korea*. 2012(1873-6327 (Electronic)).

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