



Three-month effects of Project EX: A smoking intervention pilot program with Korean adolescents[☆]

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ARTICLE INFO

Keywords:

Tobacco
Smoking cessation
Project EX
Korea

ABSTRACT

Despite current prevention and cessation efforts, adolescent smoking remains a pressing issue worldwide, including in Korea. The current study evaluates Project EX-Korea, a teen tobacco use cessation program, three months after baseline. The quasi-experimental trial intervention involved 160 smokers in 10th to 12th grade, 85 from the program condition schools and 75 from the control. At three-month follow-up, the intent-to-treat (ITT) quit rate in the program group (30.2%) was 3.6 times that of the rate in the standard care control group (9.2%; $p < 0.05$). Among those who did not quit, those in the program group smoked less on average than those in the control group, but there was no difference in follow-up mFTQ scores between the two non-quitter groups. As teen tobacco use cessation programming is much needed in Korea, Project EX is a plausible program to implement among Korean adolescents.

1. Introduction

According to the World Health Organization (WHO), global tobacco smoking prevalence has decreased from 27% in 2000 to 20% in 2016 (WHO, 2017). Likewise, the adolescent smoking rate in Korea reached its peak in 2007 (13.1%) and has since been steadily decreasing. In 2016, the overall average smoking rate among Korean adolescents was 6.2% (9.6% among males, 2.7% among females). Despite smoking control efforts worldwide, however, smoking remains a pressing public health concern, including in Korea and especially among adolescents (Korea Centers for Disease Control and Prevention, 2016). Besides the well-established issues raised by smoking (e.g., health deterrents, growth impairments, financial troubles, productivity loss), research indicates that youth smokers are more at risk of becoming habitual smokers, which in turn may heighten physiological nicotine dependence and result in greater difficulty to quit smoking as adults (Chun, Bae, & Min, 2012; Kim et al., 2016).

To address the lingering smoking problem in Korea, several studies identified cognitive behavioral techniques as part of the theoretical

basis for smoking cessation programs, especially those targeting adolescents (Chun et al., 2012; Kim, Park, & Park, 2008; Sussman, Sun, & Dent, 2006). One meta-analysis identified 22 studies on adolescent smoking cessation programs in Korea, but only two studies had sufficient sample sizes to detect even medium effect sizes. Follow-up post tests were only conducted among about a third (36%) of the studies, which makes it difficult to verify the methods, study design, and results. Although the effect size of each dependent variable (including smoking knowledge, attitudes, and amount, among others) was provided, no specific quit rates were reported in the meta-analysis, leading one to be cautious on how to interpret the results of these studies (Kim et al., 2008).

Chun et al. (2012) found that their cognitive behavioral model-based program was effective for teen Korean male smokers, which was verified with supporting results from biochemical tests measuring urine cotinine tests and carbon monoxide breath levels to assess program efficacy. Their quasi-experimental study, however, had a low sample size of only males and no females, which did not adequately represent the population and was only assessed with an immediate posttest. Since

[☆] This work was supported by the Sahmyook University Research Fund (grant number RI 12017016).

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no follow-up tests were conducted, their study may have not properly measured the program's cessation effects and may have missed changes in cessation effects over time. Additionally, although program effectiveness was assessed, no actual quit rates among the adolescents were reported (Chun et al., 2012). Another article reviewed various research regarding smoking and smoking cessation among Korean adolescents ($n = 80$ experimental studies). Although 56 studies (70%) were categorized as cessation program studies, the review did not assess program efficacy (Kim & Jeong, 2010) and findings were not readily accessible.

The current study assesses Project EX-Korea, which was adapted from the original evidence-based program, Project EX. Project EX was developed in California and received recognition from several health agencies, including National Registry of Evidence-based Programs and Practices (NREPP) of Substance Abuse and Mental Health Services Administration (SAMHSA), National Cancer Institute (NCI), and Health Canada. Project EX is theoretically based upon a teen smoking model, which focuses on how motivational factors, personal skills, and withdrawal coping mechanisms work together (Sussman et al., 2004). Previous results from Project EX pilot studies in the U.S. indicate consistently positive outcomes. Seventeen percent of students reported no relapses in an intent-to-treat assessment during three-to-six-month follow-ups, which was twice the rate of quitting compared to that of students in a control condition (Sussman, 2012).

1.1. International translation of Project EX

Following U.S. studies, the Project EX clinic program for tobacco users was implemented and evaluated in other countries (i.e., China, Russia, Spain, and Thailand) to evaluate the program's effectiveness in the contexts of different cultures with varying degrees of motivation to quit smoking (Sussman, 2012). Follow-up results reported overall positive program outcomes and that intent-to-treat (ITT) last 30-day quit rates were higher among the program group than among the control group (see Table 1).

1.2. Study objectives

Utilizing a quasi-experimental study design, the current study examines the three-month self-reported behavioral outcomes of Project EX Korea, to see if the program group would show higher ITT quit rates than the control group.

2. Methods

2.1. Recruitment and experimental design

After receiving IRB approval, we collaborated with the local Office of Education and were introduced to school teachers from five high schools located in Gyeonggi-do Province, Korea (i.e., Bulnae, Chungwon, Sewon, Sinbanghak, and Taegaewon), who expressed interest in implementing a smoking cessation program, and we explained to them what Project EX-Korea entailed. After obtaining permission and consent to implement Project EX-Korea from each school's principal, we were able to obtain a list of classrooms within which there were students who were classified as smokers through a school-based screening

Table 1
Project EX ITT last 30-day quit rates vs. control.

Author	Country	N	Follow-up	Proj EX	Control
Zheng et al., 2004	China	46	4 months	11.0%	3.0%
Idrisov et al., 2013	Russia	164	6 months	7.5%	0.1%
Espada, González, Guillén-Riquelme, Sun, & Sussman, 2014; Espada et al., 2015	Spain	211	6 months	14.3%	0.0%
Chansatitporn et al., 2016	Thailand	185	3 months	23.0%	11.0%

assessment.

All junior and high schools in Korea have full time teachers (of classes, such as Physical Education, Health, etc.), who are appointed responsibility over the management of smoking students within the school. School administration departments assigned a “guardian teacher” to recruit at-risk classrooms to the study and specifically oversee the behavioral, financial, as well as academic problems of the students within these classrooms. These classrooms were considered at-risk since more students within each class were known to be current (past 30 day) smokers, with the average class smoking rate (9.5%) being higher than the average rate among all teens in Korea (6.2%) (Korea Centers for Disease Control and Prevention, 2016). The guardian teacher approached the students from each class, and if the individuals were interested in participating, students were asked to fill out consent forms. All students approached by the guardian teacher agreed to participate, and a total of 50–60 subjects willing to be involved in the study were selected from each school.

Program implementation occurred on the classroom level within each school, as there were multiple smokers (seven to ten) within classrooms of approximately 30 youth. Among all classrooms, initially 210 10th to 12th grade subjects were identified to be past 30-day smokers; however, 50 youth were not eligible to participate in the study, since have not smoked a cigarette over the past 30-days at baseline (1 from the program condition and 49 from the standard care control condition), leaving a total baseline sample of 160 past 30-day smokers. For the program group, we initially recruited 85 participants from eight classes representing four schools, and 78 remained at the three-month follow-up assessment. For the control group, we recruited 75 participants from ten classes representing four schools, and 71 remained at the three-month follow-up assessment. After the current study ended, participants in the control group received standard smoking cessation programing traditionally provided by the teachers.

2.2. Translating, pilot testing, and culturally adapting the Project EX curriculum

The Manual & Workbook of Classroom and Clinic document was translated into Korean by a professional Korean translator in Seoul. A bilingual researcher at Sahmyook University verified the translation by reading both the English and Korean versions and made corrections afterwards. Before the program was implemented, a pilot session was tested among five high school smoker students who were recruited from one of the experimental sample schools, Bulnae High School, recommended by the guardian teachers. The following year, we recruited our experimental and control samples with the help of these teachers.

We did all the sessions with them and received their feedbacks, which helped us for to incorporate into our minor revision process. We noted that student names from a “talk show” cast (a component of the program) needed to be changed to Korean names; statistics on smoking prevalence in the U.S. needed to be changed to those in Korea; and program components in the form of talk shows were unfamiliar to students who were accustomed solely to teacher-centered lectures and discussion formats. However, participants were familiar with TV talk show programs and showed interest in the novelty of participating in the talk show format.

2.3. Translation and cultural adaptation

According to the pilot study feedback, the following changes were made to the Project EX curriculum to better adapt it to the Korean culture: (1) Since chewing tobacco is not popular among Korean adolescents, the contents related to chewing tobacco were deleted. (2) All of the characters' names in the talk shows were changed from American to Korean names. (3) All of the American smoking-related statistics were changed to local statistics. (4) In Session 2, “Dangers of Smoking on Health,” the U.S. currency was changed to Korean currency for the

“Cigarette on the Menu” game. (5) All helpful internet sites in Session 5 were changed to local sites. (6) In Session 6, “Managing a Healthy Body,” an instructional yoga exercise video was created using high school-aged actors to show students how to properly follow the positions taught.

2.4. Training and implementation

After the initial revision of the material and three weeks prior to study implementation, nine research assistants (graduate students in Sahmyook's masters' programs: three males, six females) were trained on how to properly implement Project EX by the Korean faculty team, who previously had been trained by Dr. Sussman (in a one-day meeting in Seoul). The training sessions, which lasted a total of 10 hours over the course of a day and a half, were designed to be simulations of real-life clinical sessions to be implemented in the near-future. Two trained session leads, one main and one assisting, were assigned to each school.

For the experimental group, a total of eight clinic sessions were delivered, with one session occurring each week. Each session lasted 60 minutes, with a 10-minute break time. The program was conducted at a pre-assigned time during class periods at the high schools. This accommodation was made since students would be reluctant to stay in school after classes had ended. Snacks were provided during each clinic session as well.

For the control group, the students received two one-hour lectures on the hazards of smoking. All junior and high school students in Korea are required to attend this smoking cessation lecture once each semester every school year. Each school is supported by the Ministry of Education to host these lectures, which are usually delivered by an outside speaker who is trained to deliver this type of material. The experimental group of students also attended these mandatory lectures in addition to the intervention.

2.5. Data collection

Paper-and-pencil pretest and posttest questionnaires were administered at the beginning of the first and at the end of the eighth sessions. The follow-up assessment was conducted three months after the last session of the study. For both the program and control groups, teachers were not present while participants completed the questionnaires. Participants were asked to put their predetermined identification numbers on the questionnaires, which were also placed into envelopes after completion, and were assured that the questionnaire would only be used for research purposes and that their information would be kept confidential at all times.

2.6. Questionnaire measures

Demographic items included age (in years), gender, living situation, and ethnicity (all subjects were Korean). The living situation was assessed by asking: “Who do you live with?” Response options included “both parents (or step parents),” “only with my mother (or stepmother),” “only with father (or stepfather),” “sometimes with my mother (or stepmother) and sometimes with my father (or stepfather),” and “other.” Since the majority of the participants indicated that they live with both parents (88.2%), response options for this question were collapsed into two categories: “both parents (or step parents)” and “other.”

We assessed the level of smoking at pretest by asking: “How many times have you used cigarettes in the past month (30 days) – or on an average day,” with open-ended responses, collecting times of smoking (e.g., Sussman, Dent, & Lichtman, 2001). The baseline level of nicotine dependence was evaluated through the 7-item modified Fagerstrom Tolerance Questionnaire (mFTQ), which has been shown to be successfully used (both in the U.S. and abroad) to measure nicotine dependence among adolescent smokers (Chen et al., 2002; Prokhorov et al., 2017; Prokhorov, Pallonen, Fava, Ding, & Niaura, 1996).

We assessed the student responsiveness to the program with an immediate posttest questionnaire and evaluated ratings of the program quality. Students were instructed to form an opinion about the program based on what they thought about the program, including the topics and activities completed each day. We provided six questions, each with a ten-point answer scale ranging from 1 = “not at all” to 10 = “extremely”: “How helpful/interesting/informative/well-organized was the class for quitting smoking?” and “How enthusiastic/well-informed was the teacher (leader) of the class?” Similar to a previous study (i.e., Sussman et al., 2001), these items were highly inter-correlated (Cronbach's $\alpha = 0.90$ for the current study); thus, ratings across the items were averaged to comprise a perceived program quality index. We assessed the students' likeability of the key EX curriculum activities (8 total activities, from 1 = “terrible” to 9 = “excellent”). The activities included 1) Talk Show: Family and Friends Confront Smokers About Their Habit; 2) Talk Show: Cigarettes May be Stressing You Out; 3) Healthy Breathing; 4) Game: Is Smoking on the Menu?; 5) Talk show: Quitting Smoking: I've Been There and It Does Get Better; 6) Yoga; 7) Meditation; and 8) Talk Show: WARNING! Waiting to Quit Smoking may Be Hazardous to Your Peace of Mind. The reliability of the scale was very high (Cronbach's alpha = 0.97), so we took the average of these eight items to calculate the overall likeability of program activities.

We assessed baseline and immediate posttest future smoking expectation (e.g., Ramo, Prochaska, & Myers, 2010; Sun et al., 2007), intention to ever quit smoking (e.g., Fagan et al., 2007), and motivation to quit smoking (e.g., McCuller, Sussman, Wapner, Dent, & Weiss, 2006). In order to assess future smoking expectation, we asked: “How likely is it that you will smoke cigarettes in the next 12 months? Would you say...,” The response options included: “definitely not”, “probably not”, “little likely”, “somewhat likely”, and “very likely”. Answers of anything other than “definitely not” were coded as susceptible to smoking. We asked “Do you think you will ever quit smoking cigarettes?” to assess the intention to ever quit smoking. There were four response options: “Yes, I already have”, “Yes, I will sometime in the future”, “Yes, I will in the next few weeks”, “Maybe”, and “No”. If students selected “No”, they were coded as having no intention to quit smoking. To evaluate the motivation to quit smoking, we asked four questions: “How much energy (or effort, or desire) do you have to quit tobacco now and/or stay stopped?” and “How much direction do you feel you are receiving to quit now and/or stay stopped?” The response options for each question were: “None,” “A Little,” “Some,” and “A lot”. The reliability of the scale was high: Cronbach's alphas for baseline and immediate posttest motivation to quit smoking items were 0.80 and 0.82, respectively. We took the average of these four items to calculate the motivation to quit smoking index.

2.7. Data analysis

Using bivariate analysis, we assessed the baseline comparability across conditions with regards to age, gender, family structure, mFTQ score, baseline past 30-day, and an average day cigarette smoking. We assessed the potential sampling bias due to attrition at follow-up by comparing the sample that was lost at 3-month follow-up ($n = 11$) to the participants that were surveyed at both pretest and follow-up ($n = 149$). The comparisons were made on eleven key variables assessed at pretest. Measures included: age, gender, living with situation, future smoking expectation, intention to ever quit smoking, motivation to quit smoking, number of cigarettes smoked in past 30-days, an average day smoking level, program condition (EX or control), school, and mFTQ nicotine dependence level. The comparisons utilized chi-square tests or *t*-tests to indicate statistically significant differences (two-tailed $p \leq 0.05$). To control for baseline missing item-level data, using the multivariate imputations by chained equations (MICE) method for missing at random assumptions and the available covariate data, 25 imputed data sets were created. The pooling of the regression

estimates followed Rubin's rule (White, Royston, & Wood, 2011).

Program condition receptivity was examined at immediate posttest through a look at simple mean ratings on the receptivity measure (program quality and likeability). A Tukey correction was provided for use of multiple tests. The immediate posttest program outcomes were evaluated with three items: 1) next year future smoking expectation, 2) lack of intention to ever quit smoking, and 3) motivation to quit smoking which were all adjusted for pretest measure of the outcome, age, gender, family structure, school, baseline mFTQ nicotine dependence level, and an average day smoking level.

Three smoking behavior outcomes were assessed at the three-month follow-up: 1) intent-to-treat (ITT) past 30-day quit rate, 2) number of cigarette smoked on an average day for those who did not quit at follow-up, and 3) change in mFTQ scores (follow-up – baseline) for those who did not quit at follow-up. Based on the intraclass correlation of 0.23, 0.07, and 0.10 (respectively for each outcome) and the average cluster size, we used a multilevel modeling approach to control for the nesting of students (Level 1) within classrooms schools (Level 2). The variables adjusted for in the analyses included: age, gender, family structure, school, baseline mFTQ nicotine dependence level, and an average day smoking level. All statistical analyses were conducted using SAS software (version 9.4; SAS Institute, Cary, NC).

3. Results

3.1. Participants, and baseline and three-month differences

There were only seven females in the sample (95.6% male), and all youth were Korean. Their ages ranged from 14-to-20 years (mean = 17.5; SD = 1.3; 93% of the sample fell between the ages of 16 and 19 years). Overall, the mean level of past 30-day and an average day smoking across both conditions at baseline were 120.0 (SD = 132.9) and 10.1 (6.3) cigarettes, respectively, and the mean mFTQ score across conditions was 4.2 (SD = 1.5). The mean level of past 30-day and an average day smoking across both conditions at three-month follow-up were 91.0 (SD = 158.8) and 7.5 (SD = 9.7) cigarettes, respectively, and the mean mFTQ score across conditions was 4.0 (SD = 1.8), (see Table 2).

In terms of group differences, the treatment group's level of past 30-day smoking was 115.1 (SD = 119.4) at baseline and 66.6 (SD = 124.5) at three-month follow-up, while the control group's level of past 30-day smoking was 125.2 (SD = 146.8) at baseline and 111.2 (SD = 180.8) at three-month follow-up. The treatment group smoked

11.5 cigarettes (SD = 9.2) at baseline and 6.3 cigarettes (SD = 8.9) at follow-up, while the control group smoked 8.6 cigarettes at both baseline and follow-up (SD = 8.0 and 10.1, respectively). The treatment group's mFTQ score at baseline was 4.2 (SD = 1.5) and 4.0 (SD = 1.8) at follow-up, while the control group's mFTQ score at baseline was 3.9 (SD = 2.2) and 3.9 (SD = 1.9) at follow-up (see Table 2).

3.2. Assessment of baseline comparability and attrition bias

Attrition was 6.9% (i.e., 149 out of 160 smokers remained and were assessed at three-month follow-up). At three-month follow-up, seven subjects dropped from the treatment group and four from the control. The bivariate analyses did not find any statistical differences between those who dropped and those who remained in the study, with regards to baseline age, gender, family structure, treatment condition, mFTQ scores, intention and motivation quit smoking, future smoking expectation, number cigarettes smoked on an average day smoking, and past 30-day smoking level. The baseline comparability analysis showed that there were no statistical differences between program conditions (EX and control) on gender, family structure, baseline past 30-day smoking level. However, *t*-tests revealed that those in the treatment condition were younger (16.8 years vs. 18.4 years, $p < 0.01$), had higher baseline mFTQ scores (4.5 vs. 3.9, $p = 0.01$), and smoked more cigarettes on an average day (11.5 vs. 8.6, $p < 0.01$), compared to those in the control condition.

3.3. Receptivity analysis and program effects at immediate posttest

The average overall program process quality rating was 8.5 (SD = 1.5) and 7.8 (SD = 1.9) for average overall program likeability, indicating that the activities were moderately well-liked. "Healthy Breathing" was the most likeable activity (8.2), while "Meditation" (7.6) and "Yoga" (7.7) were the least preferable ($p < 0.05$). The scores for all eight key activities are shown in Table 3.

At immediate posttest, multilevel model analysis showed that, after adjusting for covariates there were no statistical differences in future smoking expectation and intention to ever quit smoking across conditions at immediate posttest ($p = 0.29$ and $p = 0.44$, respectively). Nonetheless levels of motivation to quit smoking differed across conditions (2.9 (SD = 0.1) in treatment group vs. 2.8 (SD = 0.1) control): those in treatment group had a higher average motivation-to-quit level compared to those in control group ($\beta = 0.31$; CI: 0.03, 0.59; $p = 0.03$).

Table 2
Participant characteristics for the total sample and by condition.

	Total sample N = 160	Treatment condition (n = 85)	Control condition (n = 75)	p-Value ^a
Age (M, SD)	17.5 (1.3)	16.8 (1.1)	18.4 (1.0)	< 0.01*
Gender				
Male (%)	153 (95.6%)	81 (95.3%)	72 (96.0%)	0.83
Family structure				
Both parents (%)	141 (88.1%)	74 (87.5%)	66 (88.6%)	0.81
Past 30-day smoking at baseline (M, SD)	120.0 (132.9)	115.1 (119.4)	125.2 (146.8)	0.64
Past 30-day smoking at follow-up ^b (M, SD)	91.0 (158.8)	66.6 (124.5)	111.2 (180.8)	0.12
Number of cigarettes smoked on an average day at baseline (M, SD)	10.1 (6.3)	11.5 (9.2)	8.6 (8.0)	< 0.01*
Number of cigarettes smoked on an average day at follow-up ^b (M, SD)	7.5 (9.7)	6.3 (8.9)	8.6 (10.1)	< 0.01*
Baseline mFTQ score ^c (M, SD)	4.2 (1.5)	4.5 (2.2)	3.9 (2.2)	0.01*
Follow-up ^b mFTQ score ^c (M, SD)	4.0 (1.8)	4.1 (1.7)	3.9 (1.9)	0.70

^a For the difference between treatment and control conditions; *significant p-value.

^b Three-month follow-up.

^c Total score cut-offs, indicating level of nicotine dependence: 0–2 = no dependence; 3–5 = moderate dependence; 6–9 = substantial dependence (Prokhorov et al., 1996, 2017).

Table 3
“Likeability” ratings of eight key activities in Project EX-Korea.

Activity name	Mean	SD
Talk Show: Family and Friends Confront Smokers About Their Habit	7.69 ^b	2.09
Talk Show: Cigarettes May be Stressing You Out	7.83 ^{ab}	2.03
Healthy Breathing	8.23 ^a	1.90
Game: Is Smoking on the Menu?	7.93 ^{ab}	2.06
Talk show: Quitting Smoking: I've Been There and It Does Get Better	7.79 ^{ab}	2.06
Yoga	7.65 ^b	2.36
Meditation	7.62 ^b	2.46
Talk Show: WARNING! Waiting to Quit Smoking may Be Hazardous to Your Peace of Mind	7.80 ^{ab}	2.27

Different superscript letters indicate significant differences between groups at $p < 0.05$ (two-tailed t -tests); p -value is based on Tukey's correction.

3.4. Program effects at three-month follow-up

The intent-to-treat (ITT) past-30 day quit rates at three-month follow-up were 30.2% in the program condition (26 quitters), and 9.1% in the control condition (6 quitters). A multilevel model revealed that after adjusting for covariates, those in the program condition were more likely to quit smoking, than those in the control group (OR = 12.17; CI: 2.73–54.25; $p < 0.01$).

Among those who did not quit tobacco use, a multilevel model showed that those in the program group used less cigarettes on average compared to those in the control group ($\beta = -5.26$; CI: -7.73 ; -2.80 ; $p < 0.01$). The program condition mean was 6.3 cigarettes smoked on average (SD = 8.9), and the control condition mean was 8.6 (SD = 10.1). Among those who did not quit tobacco use, a multilevel model failed to find differences across conditions on change in mFTQ scores ($p = 0.80$). Yet, mean mFTQ reduced by -0.2 (SD = 1.1) in the program condition, while increased by 0.2 (SD = 1.4) in the control condition.

4. Discussion

Based on immediate posttest results, the average smoking levels across both conditions indicate a high overall prevalence of smoking among Korean adolescents as well as a moderate level of nicotine dependence, highlighting the need for the development and implementation of effective tobacco cessation programs in Korea. We observed a moderately high average program quality rating indicating a high overall likeability rating of program activities, which may facilitate program effectiveness and participants' willingness to comply to/follow through with program components.

On average, participants in both the treatment and control groups reported a lower level of past 30-day smoking. However, while those in the control group failed to show a mean change in the number of cigarettes smoked on an average day or in mFTQ scores, the treatment group showed a decrease in the number of cigarettes smoked on an average day and in mFTQ scores, indicating a positive outcome for those who participated in this study in terms of smoking less and having less dependence on cigarettes. Intent-to-treat (ITT) past-30 day quit rates in the program condition were more than three and a half times that of the ITT rate in the control condition at three-month follow up. The purpose of the three-month follow up testing was to ensure that results were valid and to see if there were any changes in quit rates over time. Even if participants did not quit, those who were part of the program group reported somewhat lower smoking rates than those in the control group. This suggests that implementing Project EX among teens is a step towards reduced adolescent tobacco use and tobacco use cessation.

4.1. Study limitations and future research directions

First, only a convenience sample of teens within one province in Korea was assessed. Although the results of the study can be generalized to Gyeonggi-do Province adolescents, our findings may not be representative of all Korean adolescents. Additionally, our sample was predominantly comprised of boy smokers, hence our results may have a limited generalizability on adolescent girls. Out of 70,000 middle and high school students stratified and randomly sampled, the prevalence of smoking among males was 9.6% (6720 students) and 2.7% among females (1890 students) (Korea Centers for Disease Control and Prevention, 2016). Although the smoking prevalence is much higher among males than females, the fact that there are female adolescent smokers at all warrants the need for an evidence base gathered on females. To enhance generalizability, future research will require larger, gender-balanced sample sizes from additional Korean provinces, including other areas of different socioeconomic and cultural perspectives (e.g., rural versus city location), to better assess tobacco use cessation programming nationwide.

Second, although low attrition is preferred in research, the study's low level of attrition may be attributed to cultural aspects of Koreans being respectful of programs implemented through the school system or entities with authority, so this sample group may not be representative of other countries if comparing on a worldwide scale. Since all participants were recruited by “guardian teachers,” their apparently heavy influence on the participants make social desirability bias a possible threat to the validity of the study results.

Third, another limitation may be the lack of biochemical data (e.g., Chun et al., 2012), for the purpose of validating and supporting survey data. However, assessing mFTQ scores is a valid measure that we used, which was tested in other studies involving saliva testing (Prokhorov et al., 1996, 2017).

Fourth, participants in the treatment group were younger, reported higher baseline mFTQ scores, and smoked more cigarettes at baseline than the control group. We controlled for demographic and baseline variables in our analyses to ensure that outcome statistics would not be compromised by baseline differences (i.e., age, baseline mFTQ scores, and cigarette use/smoking levels), which effectively allowed the results to be interpreted between the two groups without the variables affecting the end results. Heavier more dependent smokers are relatively less likely to quit (Sussman et al., 2001). Thus, without controlling for baseline differences, the study conditions would have been biased against finding program effects.

Fifth, it would benefit to run longer follow-ups to assess the long-term effects of the intervention, such as six-month or one-year follow-ups, to continue assessing and ensuring program efficacy.

Besides these limitations, strengths of this study include Project EX Korea apparently serving as a successful evidence-based approach to achieve teen tobacco use cessation. Project EX could be one of the components to help meet Korea's need for effective teen tobacco use cessation programming.

An important future research direction would be to assess other up-and-coming tobacco products (e.g., electronic cigarettes). Studies have suggested that further research is necessary to explore the emerging public health threat of e-cigarette and other vape product use and to determine if e-cigarette use is a gateway to smoking cigarettes rather than a smoking cessation method (Cho, Dutra, & Glantz, 2018; Lee et al., 2017).

4.2. Implications

Considering the limited availability of effective smoking cessation program for adolescent smokers, the current study significantly contributes to smoking cessation literature. We report findings of a novel smoking cessation program implemented for adolescent smokers in Korea. Implications of the quasi-experiment results indicate that

adolescent smokers who were enrolled in the treatment group experienced higher quit rates or smoked fewer cigarettes than those in the control group, which supports the use of this program not only around Korea but also around the world for other areas needing a tested and validated smoking cessation program.

Declaration of interest

None.

The authors claim no conflict of interest.

References

- Chansatitporn, N., Charoenca1, N., Sidhu, A., Lapvongwatana, P., Kungskulniti, N., & Sussman, S. (2016). Three-month effects of Project EX: A smoking intervention pilot program with Thai adolescents. *Addictive Behaviors*, *61*, 20–24.
- Chen, X., Zheng, H., Sussman, S., Gong, J., Stacy, A., Xia, J., ... Johnson, C. A. (2002). Use of the Fagerstrom Tolerance Questionnaire for measuring nicotine dependence among adolescent smokers in China: A pilot test. *Psychology of Addictive Behaviors*, *16*, 260–263.
- Cho, H. J., Dutra, L. M., & Glantz, S. A. (2018). Differences in adolescent e-cigarette and cigarette prevalence in two policy environments: South Korea and the United States. *Nicotine & Tobacco Research*, *20*(8), 949–953 (ntx198).
- Chun, J., Bae, Y. J., & Min, S. K. (2012). Effectiveness of smoking cessation program for male adolescents in South Korea. *Children and Youth Services Review*, *34*(1), 304–310.
- Espada, J. P., González, M. T., Guillén-Riquelme, A., Sun, P., & Sussman, S. (2014). Immediate effects of Project EX in Spain: A classroom-based smoking prevention and cessation intervention program. *Journal of Drug Education*, *44*, 3–18.
- Espada, J. P., González, M. T., Orgilés, M., Guillén-Riquelme, A., Soto, D., & Sussman, S. (2015). Pilot clinic study of Project EX for smoking cessation with Spanish adolescents. *Addictive Behaviors*, *45*, 226–231.
- Fagan, P., Auguston, E., Backinger, C. L., O'Connell, M. E., Vollinger, R. E., Kaufman, A., & Gibson, J. T. (2007). Quit attempts and intention to quit cigarette smoking among young adults in the United States. *American Journal of Public Health*, *97*, 1412–1420.
- Idrisov, B., Sun, P., Akhmadeeva, L., Arpawong, T. E., Kukhareva, P., & Sussman, S. (2013). Immediate and six-month effects of Project EX Russia: A smoking cessation intervention pilot program. *Addictive Behaviors*, *38*, 2402–2408.
- Kim, S. R., Kim, H. K., Kim, J. Y., Kim, H. Y., Ko, S. H., & Park, M. (2016). Smoking cessation failure among Korean adolescents. *The Journal of School Nursing*, *32*(3), 155–163.
- Kim, Y., Park, I., & Park, J. (2008). Meta-analysis of effects on adolescent smoking cessation programs in Korea. *Journal of Korean Academy of Nursing*, *38*(2), 204–216.
- Kim, Y. S., & Jeong, B. R. (2010). An analysis of articles related to smoking and smoking cessation of Korean adolescents. *Journal of Korean Academy of Community Health Nursing*, *21*(1), 53–62.
- Korea Centers for Disease Control and Prevention. *The twelfth Korea youth risk behavior web-based survey. (2016)*. <http://yhs.cdc.go.kr/> (Osong, Korea).
- Lee, J. H., Kim, M. J., Kim, S. J., Sim, E. S., Kim, H., Mo, E., & Chae, B. (2017). A comparative analysis of electronic cigarette smoking and smoking cessation trial related factors in adolescent: The Korea youth risk behavior web-based survey 2014. *Journal of the Korean Society for Research on Nicotine and Tobacco*, *8*, 65–72.
- McCuller, W. J., Sussman, S., Wapner, M., Dent, C., & Weiss, D. J. (2006). Motivation to quit as a mediator of tobacco cessation among at-risk youth. *Addictive Behaviors*, *31*, 880–888.
- Prokhorov, A. V., Khalil, G. E., Foster, D. W., Marani, S. K., Guindani, M., Espada, J. P., ... Tewari, A. (2017). Testing the nicotine dependence measure mFTQ for adolescent smokers: A multinational investigation. *The American Journal on Addictions*, *26*(7), 689–696.
- Prokhorov, A. V., Pallonen, U. E., Fava, J. L., Ding, L., & Niaura, R. (1996). Measuring nicotine dependence among high-risk adolescent smokers. *Addictive Behaviors*, *21*, 117–127.
- Ramo, D. E., Prochaska, J. J., & Myers, M. G. (2010). Intentions to quit smoking among youth in substance abuse treatment. *Drug and Alcohol Dependence*, *106*, 48–51.
- Sun, P., Unger, J. B., Guo, Q., Gong, J., Ma, H., Palmer, P. H., ... Johnson, C. A. (2007). Comorbidity between depression and smoking moderates the effect of a smoking prevention program among boys in China. *Nicotine & Tobacco Research*, *9*, S599–S609.
- Sussman, S. (2012). International Translation of Project EX: A Teen Tobacco Use Cessation Program. *Sucht*, *58*(5), 317–325.
- Sussman, S., Dent, C. W., & Lichtman, K. L. (2001). Project EX: Outcomes of a teen smoking cessation program. *Addictive Behaviors*, *26*, 425–438.
- Sussman, S., McCuller, W. J., Zheng, H., Pflingston, Y. M., Miyano, J., & Dent, C. W. (2004). Project EX: A program of empirical research on adolescent tobacco use cessation. *Tobacco Induced Diseases*, *2*, 119–132.
- Sussman, S., Sun, P., & Dent, C. W. (2006). A meta-analysis of teen cigarette smoking cessation. *Health Psychology*, *25*(5), 549–557.
- White, I. R., Royston, P., & Wood, A. M. (2011). Multiple imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine*, *30*(4), 377–399.
- World Health Organization (WHO). *WHO report on the global tobacco epidemic, 2017: Monitoring tobacco use and prevention policies; executive summary. (2017)*. <http://apps.who.int/iris/bitstream/handle/10665/255874/9789241512824-eng.pdf?sequence=1> (Geneva, Switzerland).
- Zheng, H., Sussman, S., Chen, X., Wang, Y., Xia, J., Gong, J., ... Johnson, C. A. (2004). Project EX-A teen smoking cessation initial study in Wuhan, China. *Addictive Behaviors*, *29*(9), 1725–1733.