



## ORIGINAL ARTICLE

# Comparisons of the stages and psychosocial factors of smoking cessation and coping strategies for smoking cessation in college student smokers: Conventional cigarette smokers compared to dual smokers of conventional and e-cigarettes

HyunSoo OH, BoAe IM and WhaSook SEO *Department of Nursing, Inha University, Incheon, South Korea*

## Abstract

**Aim:** This study was conducted to compare conventional cigarette and dual smokers (users of both conventional and e-cigarettes) with respect to the stages of smoking cessation behavior change and psychosocial factors and coping strategies for smoking cessation among college students.

**Methods:** Using convenience and snowball sampling methods, 300 college student smokers were recruited. The data were collected from July to December, 2016. The data included the general characteristics of the participants, information related to smoking and smoking cessation, the stages of smoking cessation behaviors, self-efficacy in, and barriers to, smoking cessation, and adoption of coping strategies for smoking cessation.

**Results:** The prevalence of e-cigarette use in the cohort was 19.3%. Nicotine dependence in the dual smoker group was significantly higher than that in the conventional cigarette smoker group. No significant intergroup differences were observed for the stage of smoking cessation behavior and self-efficacy in, and perceived barriers to, smoking cessation. However, the dual smokers had a significantly higher prevalence of quit attempts and were more likely to adopt smoking cessation coping strategies.

**Conclusions:** The findings indicated that the dual smokers had higher levels of nicotine dependence, but were more likely to attempt to quit smoking and adopt smoking cessation coping strategies. This implies that dual smokers might find it more difficult to quit smoking related to higher nicotine dependence, despite having a higher motivation for smoking cessation. These characteristics should be considered when developing smoking cessation strategies for e-cigarette smokers. In addition, different approaches to smoking cessation education should be used for e-cigarette and conventional cigarette smokers.

**Key words:** e-cigarettes, smoking behavior, smoking cessation.

## INTRODUCTION

Smoking behaviors among young adults pose serious concerns because the lifestyle habits that develop in young adults often persist throughout life (Paek & Kwon, 2011). College students are a major group in the young adult population, and because they experience

large changes in physical and psychosocial functioning, high workloads, and stressful events, they are more likely to adopt unhealthy behaviors, such as alcohol consumption, smoking, or drug abuse (Eaton *et al.*, 2010). It has been emphasized that young smokers begin simply out of curiosity and often become regular smokers throughout their adult life (Patterson, Lerman, Kaufmann, Neuner, & Audrain-McGovern, 2004).

To reduce the smoking rate, the South Korean Government has prohibited cigarette commercials on radio and television, banned smoking in public places,

*Correspondence:* WhaSook Seo, Department of Nursing, College of Medicine, Inha University, YongHyun Dong 253, Incheon 402-751, South Korea. Email: wschang@inha.ac.kr

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increased cigarette prices, required cautionary text and graphic warnings on cigarette packs, and opened nationwide smoking cessation clinics at public health centers. These efforts might contribute to increasing the number of adult smokers who consider quitting smoking (Sin & Suh, 2013). However, such social pressures and constraints on smokers might lead to a rapid growth in the use of alternatives to conventional cigarettes. Electronic cigarettes (e-cigarettes) are used as an alternative and even as an aid to help quit smoking (Korea Customs Services, 2016). Although the e-cigarette industry claims that e-cigarettes are less harmful than conventional cigarettes, it has been shown that most e-cigarettes contain a range of chemicals, which are known to cause serious damage to health on repeated exposure (Chapman & Wu, 2014). Furthermore, e-cigarettes do not appear to be effective in helping people to quit smoking (Chapman & Wu; Primack, Soneji, Stoolmiller, Fine, & Sargent, 2015).

According to the Korea Centers for Disease Control & Prevention (Korean National Health and Nutrition Examination Survey, 2015), younger adults are more likely to be life-long e-cigarette smokers. Choi and Hwang (2016) reported that Korean college students believed that e-cigarettes were less harmful than conventional cigarettes and that they might help them to quit smoking. Lee (2015) reported the most common reasons for adolescents to use e-cigarettes were curiosity and as a novel alternative to conventional cigarettes and that even non-smoking adolescents had tried e-cigarettes due to curiosity or peer influences.

Referring to evidence from international studies, the prevalence of e-cigarette over-use is the highest among adolescents (Adkison *et al.*, 2013; Chapman & Wu, 2014). The greatest concerns regarding e-cigarette use among adolescents and young adults are nicotine addiction and that they act as a gateway to tobacco use (Primack *et al.*, 2015; Riker, Lee, Darville, & Hahn, 2012). The growing numbers of e-cigarette users demand further efforts to be expended to determine the characteristics of quitting behaviors in this group. However, only a limited number of studies has been published on the process or stage of smoking cessation behavior changes and related factors among e-cigarette smokers.

As smoking cessation behaviors are commonly explained by an individual's readiness to adopt this behavior, the Transtheoretical Model of Change (TTM) was used to assess the stages of smoking cessation behaviors among e-cigarette smokers (Prochaska & DiClemente, 1983). The TTM originally was developed by Prochaska and DiClemente and identifies five stages

of behavior change (precontemplation, contemplation, preparation, action, and maintenance). This model has been frequently adopted to illustrate smoking cessation behavior (Chang, Kim, Kil, Seomun, & Lee, 2005; Prochaska & DiClemente; Prochaska & Velicer, 1997). The precontemplation stage is when a current smoker has no intention to quit smoking in the near future, whereas the contemplation stage is the stage of intending to quit within 6 months. The preparation stage is defined as the intention to quit within 1 month. The action stage is defined as that of a smoker who has stopped smoking for <6 months and the maintenance stage as that of a smoker who has stopped smoking for >6 months (Prochaska, Velicer, DiClemente, & Fava, 1988; Prochaska & Velicer). The TTM presents 10 (five experiential and five behavioral) strategies that can be used to promote behavior changes (Prochaska & Velicer; Velicer, Rossi, Prochaska, & DiClemente, 1996).

It is important that the characteristics of quitting behaviors of e-cigarette smokers are understood in order to devise effective strategies for smoking cessation in this group. As most e-cigarette smokers, particularly college students, have been found to be dual smokers of conventional and e-cigarettes (Bullen *et al.*, 2010; Dawkins, Turner, Hasna, & Soar, 2012; Lee, Lin, Seo, & Lohrmann, 2017), both dual and conventional cigarette smokers were compared in order to detect the specific characteristics of quitting behaviors that are possessed by e-cigarette smokers.

## METHODS

### Aim

The present study was conducted in order to compare conventional cigarette smokers and dual smokers (the users of both conventional and e-cigarettes) with respect to the stages, psychosocial factors, and coping strategies for smoking cessation among college students. The specific study aims were to compare conventional cigarette and dual smokers in terms of the: (i) characteristics related to smoking and smoking cessation; (ii) stages of smoking cessation behavior change; (iii) psychosocial factors, such as self-efficacy in, and perceived barriers to, smoking cessation; and (iv) adoption of coping strategies.

### Study design and participants

A non-experimental, cross-sectional study design was adopted. Three-hundred college student smokers were recruited. Only those participants who satisfied the

following criteria were included: (i) aged between 19 and 35 years; (ii) the ability to read and comprehend the questionnaire, which was written in Korean; and (iii) the provision of informed consent. As the focus was on young adults, the study participants were aged from 19 to 35 years. In the present study, “dual smokers” were defined as daily conventional cigarette smokers who also used e-cigarettes regularly (at least three times per week). Daily conventional cigarette smokers who used e-cigarettes less than three times per week were classified into the conventional smoking group.

According to the power analysis that was conducted by using the G\*power 3.1 program (Faul, Erdfelder, Buchner, & Lang, 2009), the minimum sample size that was required was 278 (MANOVA test,  $\alpha = 0.05$ , effect size = 0.10, power( $1-\beta$ ) = 0.90, number of groups = 2). As no related study has been conducted previously, a conservatively small effect size was estimated at 0.10, based on Cohen’s criteria for the effect size of  $r$  (Cohen, 1988). Although the minimum sample size was calculated as 278, data collection was conducted for 300 individuals in order to account for an expected loss of  $\approx 10\%$  due to missing data or erratic responses. The missing data rule that was used in the present study was that if  $>20\%$  of the data was missing, then the data for that participant were excluded from the study. However, none were excluded due to missing data.

In order to obtain a sample of 300 college student smokers, the study participants were recruited from all nine universities and colleges in Incheon, South Korea. As there was no list of college student smokers or sources for locating them, random sampling was unable to be used. Instead, the snowball sampling method was used to obtain the required number of participants in the present study. Snowball sampling is a type of convenience sampling method, in which the initial study participants help to identify other potential study participants. This sampling method has been used to access low-incidence populations and individuals who are difficult to locate (Polit & Beck, 2011).

### Data collection procedure

The data were collected from July to December, 2016 by the second author. Recruitment notices containing a brief description of the study’s purpose, procedures, inclusion criteria, and contact information were posted on bulletin boards in the nine universities. When the potential participants first contacted the second author of the present study via email or phone, a brief screening was carried out in order to ensure that they met the

necessary criteria for either the convenient smoking group or the dual smoking group. The initially contacting individuals then introduced their friends and classmates. When making initial contact with the potential participants, their convenient dates, times, and places for individual participant meetings were scheduled. The data were collected individually from each participant in student lounges or empty classrooms on university campuses or at mutually convenient locations (cafeterias, coffee shops, or outdoor tables around the campus). After completing the questionnaire, unexpected small gifts of stationery (worth \$3) were awarded to the participants.

### Measures

#### *Demographic characteristics, current health status, and smoking- and smoking cessation-related information*

Demographic characteristics (sex, age), current health status (Body Mass Index [BMI], blood pressure, underlying disease), and smoking- and smoking cessation-related information (current and past smoking status, duration and amount of smoking, age at first smoke, age at starting smoking, use of e-cigarettes, nicotine dependence, smoking cessation attempts, reasons for smoking cessation attempts, duration of abstinence methods, smoking-related symptoms) were obtained by using a self-report questionnaire.

The BMI was calculated as the body weight divided by the square of the body height ( $\text{kg/m}^2$ ) and the latest blood pressure was collected from the participants. Smoking-related symptoms were assessed with a question of yes/no options about the presence of each of the following symptoms in the previous 6 months: hypertension, chest pain, sore throat, sputum, coughing, or dyspnea (the most common smoking-related symptoms reported in the literature). Supplementary qualitative data also were collected in order to allow the e-cigarette smokers to describe specific reasons for smoking e-cigarettes.

#### *Measures of the major variables*

Most of the major outcome variables were psychosocial variables that are often difficult to measure with direct observation or mechanical instruments or tools because they are constructed with individuals’ feelings, attitudes, beliefs, or perceptions. Accordingly, the psychosocial variables are commonly measured with self-report instruments. In order to minimize a potential inherent inaccuracy (measurement error) of the self-reported

data, self-report measurement tools were used that have been proven to be valid and reliable, based on psychometric test results in the psychology and public health areas.

**Nicotine dependence.** Nicotine dependence was evaluated by using the Korean version of the Fagerstrom Test for Nicotine Dependence (FTND), which was originally developed by Pomerleau, Carton, Lutzke, Flessland, and Pomerleau (1994) and translated into Korean by Ahn *et al.* (2002). The original developers verified the validity and reliability of the FTND and Ahn *et al.* also tested the translation validity, construct (nomological) validity, and reliability of the K-FTND. This tool contains six items: four yes/no items that are scored 0 or 1 and two multiple-choice items that are scored from 0 to 3 (minimum–maximum scores: 0–10), where a higher score indicates greater nicotine dependence. A Cronbach's alpha (internal consistency coefficient) for the K-FTND was reported to be 0.69 (Ahn *et al.*); in the present study, the Cronbach's alpha was 0.60. It was inferred that this low internal consistency score was probably related to a small number of total items and a high proportion of yes/no questions. The amount of nicotine per cigarette was determined based on those printed on the cigarette pack of the brand (provided by the Korea Tobacco & Ginseng Corporation, Daejeon, South Korea) that was consumed by the study participants.

**Stages of smoking cessation behavior.** Smoking cessation behavior change was classified into five stages, as described by Prochaska and DiClemente (1983): pre-contemplation, contemplation, preparation, action, and maintenance. The respondents were provided with an explanation of the characteristics of the five stages and asked one question: "At what stage of smoking cessation are you at now?" The construct validity (nomological validity) and test–retest reliability of this single-item question have been reported as adequate in other studies (Aveyard, Lancashire, Almond, & Cheng, 2002; DiClemente *et al.*, 1991). The constructs of the five stages of behavior change were translated into Korean by Chang *et al.* (2005), who also verified the translational validity.

**Adoption of coping strategies for smoking cessation.** The adoption of coping strategies for smoking cessation was assessed by using the 10 strategies that were proposed in the stages of change model by Prochaska and Velicer (1997). The 10 coping strategies included five

experiential processes (consciousness raising, dramatic relief, self-re-evaluation, environmental re-evaluation, and social liberation) and five behavioral processes (self-liberation, stimulus control, counter-condition, helping relationships, and counter-conditioning). The construct validity of this tool was verified through a confirmatory factor analysis and its reliability also was confirmed (Prochaska *et al.*, 1988). A Korean version of this scale that was translated by Chang *et al.* (2005) was used, who confirmed the content and translation validities (using a forward- and back-translation technique) and reliability (Cronbach's alpha = 0.89). The Korean version is a 5-point, 20-item (10 for experiential and 10 for behavioral strategies) scale and higher scores indicate a greater use of coping strategies for smoking cessation. The Cronbach's alpha of this scale in the present study was 0.76.

**Self-efficacy in smoking cessation.** Self-efficacy in smoking cessation was assessed by using the 10-item visual analog scale (0–100 points) that had been developed by Oh, Jeong, and Seo (2013). This scale was devised based on the Attitude–Social Influences–Efficacy scale (De Vries, Backbier, & Kok, 1994). The construct validity (known group or nomological validity) of the scale was verified and its reliability was shown to be well supported by the developers (Cronbach's alpha = 0.88). The total score of this scale ranges from 0 to 1000 and higher scores indicate higher self-efficacy in smoking cessation. The Cronbach's alpha for this scale in the present study was 0.81.

**Perceived barriers to smoking cessation.** The perceived barriers to smoking cessation were assessed by using a 10-item, 5-point scale that had been developed by Oh *et al.* (2013). This scale was devised by using the Attitude–Social Influences–Efficacy instrument that had been developed to assess the benefits of, and barriers to, smoking cessation (De Vries *et al.*, 1994). Higher scores represent greater barriers to smoking cessation. The construct validity (known group or nomological validity) of this 10-item scale also was verified by the developers and its reliability was shown to be well supported (Cronbach's alpha = 0.88). The Cronbach's alpha of this scale in the present study was 0.70.

## Data analysis

The statistical analysis was carried out by using IBM SPSS v. 23.0 (IBM Corporation, Armonk, NY, USA) software. The demographic, smoking, and smoking

cessation-related characteristics were subjected to a descriptive analysis. The conventional cigarette and dual smokers were compared with respect to smoking- and smoking cessation-related characteristics, stages, psychosocial factors of smoking cessation, and the adoption of smoking cessation coping strategies by a MANOVA, ANOVA, and Fisher's exact test. Prior to using the parametric statistics, it was confirmed that the dataset met the basic assumptions of independence, normality, linearity, and homoskedasticity. The reliabilities of the measurement tools that were used in the present study were assessed by calculating the Cronbach's alpha values.

### Ethical considerations

The study protocol was approved beforehand by the human research committee of the authors' affiliated university (IRB No. 160524-1A). It was made clear to all the participants that they were free to not participate and could withdraw from the study at any time without prejudice. It also was explained that their information would be collected anonymously and that the data would be presented as mean values (not as individual values). The study's objectives and procedures were explained to the candidate participants. Written informed consent was obtained from all who agreed to participate.

## RESULTS

### Descriptive analysis of the general characteristics

The mean age of the 300 study participants was 24.00 ( $\pm 2.95$ ) years and 264 (88.0%) were male. Based on the BMI, 211 (70.3%) participants were of normal weight, 73 (24.3%) were overweight, and 16 (5.3%) were underweight. The mean systolic and diastolic blood pressures were 123.17 ( $\pm 11.56$ ; range: 90–149) and 80.03 ( $\pm 8.69$ ; range: 60–100) mmHg, respectively. The majority of the participants ( $n = 233$ , 77.7%) had more than one smoking-related symptom, mostly sputum, coughing, and sore throat, and 20 (6.7%) had self-reported chronic disease (Table 1).

The mean age at first smoke was 18.33 ( $\pm 2.61$ ) years and the mean age at starting regular smoking was 19.61 ( $\pm 2.13$ ) years. The mean number of cigarettes smoked per day was 11.98 ( $\pm 6.23$ ) and the mean amount of nicotine per cigarette was 0.41 ( $\pm 0.19$ ) mg. Most participants ( $n = 252$ , 84.0%) had tried to stop smoking

**Table 1** Descriptive statistics of the study's participants ( $n = 300$ )

Variable	N (%) / Mean $\pm$ SD
Age	24.00 $\pm$ 2.95
Body Mass Index (kg/m <sup>2</sup> )	
Normal	211 (70.3)
Over	73 (24.3)
Under	16 (5.4)
Underlying disease	
Yes	20 (6.7)
No	280 (93.3)
Number of symptoms <sup>†</sup>	1.87 $\pm$ 1.48
Starting age of smoking (years)	19.61 $\pm$ 2.13
Amount of nicotine (mg)	0.41 $\pm$ 0.19
Number of smoking cessation attempts	3.81 $\pm$ 4.98
Side-effects of e-cigarettes <sup>‡</sup>	
Yes	20 (34.5)
No	38 (65.5)
Self-efficacy	506.13 $\pm$ 161.56
Coping strategies	57.87 $\pm$ 9.50
Sex	
Male	264 (88.0)
Female	36 (12.0)
Blood pressure (mm Hg)	
Systolic	123.17 $\pm$ 11.56
Diastolic	80.03 $\pm$ 8.69
Type of underlying disease	
Respiratory disorders	7 (35.0)
Hypertension	7 (35.0)
First smoking age (years)	18.33 $\pm$ 2.61
Number of cigarettes (per day)	11.98 $\pm$ 6.23
Cessation attempts	
$\geq$ Once	252 (84.0)
Never	48 (16.0)
Dual smoker	
Yes	58 (19.3)
No	242 (80.7)
Stages of smoking cessation	
Precontemplation	121 (40.3)
Contemplation	132 (44.0)
Preparation	47 (15.7)
Perceived barrier	25.46 $\pm$ 6.72

<sup>†</sup>Smoking-related symptoms (mostly sputum, coughing, and sore throat). <sup>‡</sup>Number (percentage) of the participants with side-effects among the dual smokers ( $n = 58$ ; the side-effects included nausea, vomiting, headache, dyspnea, skin rash, and tremor). SD, standard deviation.

more than once. Of the 300 participants, 58 (19.3%) were found to be dual smokers and 20 (34.5%) of these had experienced the side-effects of e-cigarette smoking, such as nausea, vomiting, headache, dyspnea, skin rash, or tremor (Table 1).

In terms of the stages of smoking cessation behavior, ~80% of the participants were in the precontemplation

( $n = 121$ , 40.3%) or contemplation ( $n = 132$ , 44.0%) stages. The mean scores for self-efficacy and the perceived barriers were  $506.13 (\pm 161.56)/900$  and  $25.46 (\pm 6.72)/60$ , respectively, indicating medium levels of self-efficacy in, and perceived barriers to, smoking cessation. The mean score for the adoption of coping strategies was  $57.87 (\pm 9.50)/86$ . Of the 10 coping strategies, the highest score was obtained for “self-liberation” ( $6.92 \pm 1.97/10$ ) and the lowest was for “stimulation control” ( $4.69 \pm 1.87/10$ ).

### Comparisons of the conventional cigarette and dual smokers with respect to smoking- and smoking cessation-related characteristics

The MANOVA indicated an overall intergroup difference in smoking- and smoking cessation-related characteristics (Wilk's Lambda = 0.96,  $F = 2.12$ ,  $P = 0.050$ ; Table 2) and this difference was found to be related to a significant difference in nicotine dependence ( $2.48 \pm 2.04$  for the conventional cigarette smokers and  $3.12 \pm 1.67$  for the dual smokers;  $F = 4.90$ ,  $P = 0.028$ ) and previous attempts to stop smoking

(81.8% of the conventional cigarette smokers and 93.1% of the dual smokers;  $\chi^2 = 4.43$ ,  $P = 0.044$ ; Table 2).

### Comparisons of the conventional cigarette and dual smokers with respect to the stages of smoking cessation behavior

The stages of smoking cessation behavior were not significantly different in the conventional and dual smoker groups ( $\chi^2 = 0.56$ ,  $P = 0.755$ ): 40.9% compared to 37.9%, respectively, were in the precontemplation stage, 43.0% compared to 48.3% were in the contemplation stage, and 16.1% compared to 13.8% were in the preparation stage. In both groups, the majority of the participants reported being in either the precontemplation or contemplation stage of smoking cessation behavior (Table 2).

### Comparisons of the psychosocial factors of smoking cessation in the two study groups

No overall intergroup difference was observed for smoking cessation that was related to the psychosocial

**Table 2** Comparisons of conventional cigarette and dual smokers with respect to smoking- and smoking cessation-related characteristics ( $n = 300$ )

	Conventional cigarette smoker ( <i>n</i> = 242)	Dual smoker <sup>†</sup> ( <i>n</i> = 58)	Wilks's Lambda <sup>‡</sup>		
Variable	Mean ± SD	Mean ± SD	F( <i>P</i> )	<i>F</i> <sup>§</sup>	<i>P</i> <sup>¶</sup>
Age at first smoking (years)	18.37 ± 2.62	18.17 ± 2.58	0.96	0.27	0.602
Age at starting smoking (years)	19.64 ± 2.11	19.47 ± 2.22	2.12	0.32	0.575
Number of cigarettes smoked per day	12.04 ± 5.95	11.74 ± 7.36	( <i>P</i> = 0.050)	0.11	0.746
Amount of nicotine in a cigarette used (mg)	0.41 ± 0.19	0.39 ± 0.19		0.83	0.364
Nicotine dependence score	2.48 ± 2.04	3.12 ± 1.67		4.90	0.028

  

		Conventional cigarette smokers ( <i>n</i> = 242)	Dual smokers <sup>†§</sup> ( <i>n</i> = 58)		
Variable	Category	N (%)	N (%)	χ <sup>2</sup>	<i>P</i> <sup>¶</sup>
The presence of smoking-related symptoms	Yes	187 (77.3)	46 (79.3)	0.11	0.861
	No	55 (22.7)	12 (20.7)	–	–
Past medical history <sup>††</sup>	Yes	17 (7.0)	3 (5.2)	0.26	0.775
	No	225 (93.0)	55 (94.8)		
Previous attempts of smoking cessation	Yes	198 (81.8)	54 (93.1)	4.43	0.044
	No	44 (18.2)	4 (6.9)	–	–
Stages of smoking cessation behavior	Precontemplation	99 (40.9)	22 (37.9)	0.56	0.755
	Contemplation	104 (43.0)	28 (48.3)	–	–
	Preparation	39 (16.1)	8 (13.8)	–	–

<sup>†</sup>Smokers who used both conventional cigarettes and e-cigarettes (more than three times per week). <sup>‡</sup>MANOVA. <sup>§</sup>ANOVA. <sup>¶</sup>Fisher's exact test.

<sup>††</sup>including hypertension, diabetes mellitus, heart disease, lung disease etc.  
SD, standard deviation.

factors (Wilk's  $\Lambda = 0.99$ ,  $F = 1.55$ ,  $P = 0.213$ ; Table 3); that is, both self-efficacy in, and the perceived barriers to, smoking cessation were not significantly different ( $F = 0.19$ ,  $P = 0.662$  and  $F = 1.86$ ,  $P = 0.174$ , respectively).

### Comparisons of the adoption of coping strategies for smoking cessation in the two groups

The conventional cigarette and dual smoker groups differed significantly with respect to their self-reported adoption of coping strategies (Wilk's  $\Lambda = 0.94$ ,  $F = 1.90$ ,  $P = 0.050$ ; Table 3). This difference was attributed to significant differences between the total scores ( $57.33 \pm 9.45$  for the conventional cigarette smokers and  $60.10 \pm 9.45$  for the dual smokers;  $F = 4.03$ ,  $P = 0.046$ ), dramatic relief ( $5.69 \pm 1.93$  for the conventional cigarette smokers and  $6.28 \pm 2.07$  for the dual smokers;  $F = 4.18$ ,  $P = 0.042$ ), and environmental re-evaluation ( $5.62 \pm 1.63$  for the conventional cigarette smokers and  $6.17 \pm 1.17$  for the dual smokers;  $F = 5.95$ ,  $P = 0.015$ ).

### Summary

Of the smoking-related characteristics, nicotine dependence and previous attempts to stop smoking were

significantly different between the conventional cigarette and dual smokers. No overall intergroup difference was observed for smoking cessation that was related to the psychosocial factors (self-efficacy in, and perceived barriers to, smoking cessation). The dual smokers obtained a significantly higher total score on adopting the coping strategies of the TTM for smoking cessation. Of the 10 strategies, the significant strategies that had been adopted by the dual smokers were dramatic relief and environmental re-evaluation.

## DISCUSSION

In the present study, the prevalence of e-cigarette use among the 300 smokers was 19.3%, which is much higher than the 6.6% and 1.1% prevalence of ever and current e-cigarette use among the 5338 Korean adults in Lee, Kim, and Cho (2016). This difference might have been related to the inclusion of only young adults in the present study, as it has been reported that the prevalence of e-cigarette ever-use is highest among adolescents and young adults (Bunnell *et al.*, 2015; Chapman & Wu, 2014). Aggressive e-cigarette advertisements that target youth might have contributed to the high prevalence of e-cigarette smoking among young adults (Lee, Kim, Yun, & Jee, 2011).

**Table 3** Comparisons of conventional cigarette and dual smokers with respect to self-efficacy in, and perceived barriers to, smoking cessation and the adoption of coping strategies for smoking cessation ( $n = 300$ )

Variables		Conventional cigarette smokers ( $n = 242$ ) Mean $\pm$ SD	Dual smokers <sup>†</sup> ( $n = 58$ ) Mean $\pm$ SD	Wilk's $\Lambda$ <sup>‡</sup> F( $p$ )	F <sup>§</sup>	P
Self-efficacy in smoking cessation		504.13 $\pm$ 163.22	514.48 $\pm$ 155.51	0.99	0.19	0.662
Perceived barrier to smoking cessation		25.20 $\pm$ 6.64	26.53 $\pm$ 6.98	1.55 (0.213)	1.86	0.174
Ten coping strategies for smoking cessation	Total	57.33 $\pm$ 9.45	60.10 $\pm$ 9.45	0.94	4.03	0.046
	Consciousness raising	5.69 $\pm$ 1.71	6.00 $\pm$ 1.62	1.90	1.56	0.212
	Dramatic relief	5.69 $\pm$ 1.93	6.28 $\pm$ 2.07	(0.050)	4.18	0.042
	Self-reevaluation	5.00 $\pm$ 1.96	5.24 $\pm$ 2.08		0.72	0.398
	Environmental reevaluation	5.62 $\pm$ 1.63	6.17 $\pm$ 1.17		5.95	0.015
	Social liberation	6.57 $\pm$ 1.68	7.00 $\pm$ 1.91		2.91	0.089
	Counterconditioning	5.25 $\pm$ 1.65	5.26 $\pm$ 1.52		0.00	0.978
	Helping relationship	5.91 $\pm$ 2.02	6.17 $\pm$ 2.22		0.76	0.383
	Reinforcement management	6.04 $\pm$ 2.11	6.14 $\pm$ 2.0		0.10	0.752
	Self-liberation	6.96 $\pm$ 1.95	6.78 $\pm$ 2.06		0.40	0.527
	Stimulus control	4.60 $\pm$ 1.83	5.07 $\pm$ 1.99		2.92	0.089

<sup>†</sup> Smokers who used both conventional cigarettes and e-cigarettes (more than three times per week). <sup>‡</sup> MANOVA. <sup>§</sup> ANOVA. SD, standard deviation.

According to the supplementary qualitative data that were collected during the present study, the specific reasons that were given for smoking e-cigarettes were: they can be used anywhere, especially in locations where conventional cigarette smoking is restricted; or they are less harmful. A similar finding was obtained by Kinnunen, Ollila, Lindfors, and Rimpelä (2016), who reported that allowing e-cigarette use in traditional smoking-prohibited areas led to the trying of e-cigarettes. In addition, flavors (menthol, fruit, candy etc.) and the convenience of universal serial bus battery recharging were found to be attractive factors (Zhu, 2014). The supplementary qualitative data also indicated that more than half of the study participants believed that e-cigarettes were a safe alternative to conventional cigarettes and perceived e-cigarettes as being somewhat helpful for smoking cessation. Similar findings have been consistently reported in other studies (Czoli, Goniewicz, Islam, Kotnowski, & Hammond, 2016; Sutfin, McCoy, Morrell, Hoepfner, & Wolfson, 2013).

Some e-cigarettes contain low levels of nicotine, while others can exceed the nicotine levels of conventional cigarettes. E-cigarette-induced nicotine dependence became of concern as e-cigarettes with high nicotine levels probably increased the risk of nicotine dependence. In the present study, nicotine dependence in the dual smoker group was found to be significantly higher than in the conventional cigarette smoker group, which was expected because it has been shown that highly nicotine-dependent smokers are more likely to use e-cigarettes. Furthermore, Lee *et al.* (2017) recently reported the prevalence of e-cigarette use among college students is increasing in the USA, thus concluding that more college students are now at increased risk of nicotine addiction.

No significant difference was found between the conventional cigarette smokers and the dual smokers in terms of the stages of smoking cessation behavior. In contrast, the dual smokers had a significantly higher prevalence of quit attempts. This finding suggests that young adult smokers might have used e-cigarettes as a means of quitting smoking or due to nicotine dependence, which contrasts with earlier research findings that e-cigarette use by youth and young adults is not viewed as a primary means of stopping or reducing smoking, but rather is most commonly adopted due to curiosity (Biener & Hargraves, 2015).

These findings demonstrated that the dual smokers showed a significantly greater use of coping strategies of the TTM for smoking cessation than did the

conventional cigarette smokers. Based on the notions that the TTM was developed originally as a self-help model in conjunction with smoking cessation and that the 10 strategies of the TTM address stage-based self-help guides to smoking cessation (Prochaska & Velicer, 1997), this finding might indicate that young adult e-cigarette smokers in the present study tended to prefer self-help approaches to smoking cessation.

The 10 strategies of the TTM can be divided into two types: experiential and behavioral strategies. In the present study, the significant strategies that were adopted by the dual smokers were dramatic relief and environmental re-evaluation, which were classified as experiential strategies that were used mainly during the precontemplation and contemplation stages (Prochaska & Velicer, 1997). Considering that most of the study participants were in the precontemplation or contemplation stage, it was reasonable that they reported adopting experiential strategies, such as dramatic relief and environmental re-evaluation. Dramatic relief refers to the techniques that enable an individual to express one's feelings about problem behaviors and to explore possible solutions, leading to lightening the emotional load (Prochaska & DiClemente, 1983; Prochaska & Velicer). Environmental re-evaluation is an individual's assessment of the impact of problem behaviors on others and the environment (Prochaska & DiClemente; Prochaska & Velicer). According to Lee (2014), the use of more behavioral strategies could assist individuals to progress to the advanced stages, whereas the experiential strategies have little effect on stage movement. Therefore, the finding that the dual smokers used more experiential strategies should not be interpreted to mean that the e-cigarette smokers had higher levels of implementing smoking cessation practice than the conventional cigarette smokers.

There are several limitations to this study. First, because female cigarette smoking is traditionally uncommon in Korea, most of the participants of the present study were men (87.0%). Accordingly, further studies on sex-related differences in quitting behaviors are needed. Second, the present study was limited to college students who were aged between 19 and 35 years and therefore similar studies on other age groups are also needed to provide more comprehensive information on this topic. Furthermore, comparisons of the quitting behaviors of e-cigarette smokers by age group could help to identify age-related differences. Third, the possible presence of confounding factors that might contribute to the differences that were observed between the dual and conventional smokers was not

ruled out and therefore the evaluation of causal relationships was not allowed in the present study. Fourth, the K-FTND demonstrated low internal consistency, probably related to a small number of total items and a high proportion of yes/no questions. It is suggested that the findings for this measure might need to be interpreted with caution. The final study limitation is that there might be a possibility of measurement errors because the findings of this study were based on self-reported data. To minimize the inherent inaccuracy (measurement error) of the self-reported data, measurement tools were used that previously have been proven to be valid and reliable, based on psychometric test results in psychology and public health research areas.

## CONCLUSION

In the present study, the prevalence of e-cigarette use was much higher than previously reported in South Korea. More than half of the college student smokers were found to perceive e-cigarettes as safe alternatives to conventional cigarettes and to believe that e-cigarettes somehow help smokers to stop smoking. Nicotine dependence was significantly higher in the dual smoker group, which suggests that the e-cigarette smokers could have had more difficulty in quitting. Furthermore, the dual smokers were more likely to adopt smoking cessation coping strategies, particularly experiential strategies (dramatic relief and environmental re-evaluation). However, no significant difference was observed between the conventional cigarette and dual smokers in terms of their self-reported stage of smoking cessation behavior changes, although the dual smokers had a significantly higher prevalence of quit attempts than did the conventional smokers. These findings could help when developing smoking cessation intervention programs that are tailored to e-cigarette smokers. An optimized intervention program that is matched to the characteristics of e-cigarette smokers can provide more effective support for quitting smoking.

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## DISCLOSURE

The authors declare no conflict of interest.

## AUTHOR CONTRIBUTIONS

H. O. designed the study, conducted the statistical analysis, and drafted the manuscript; B. I. designed the study, collected the data, and conducted the statistical analysis; and W. S. designed the study and wrote and finalized the manuscript.

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