



Full length article

## E-cigarettes, conventional cigarettes, and dual use in Korean adolescents and university students: Prevalence and risk factors



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### ABSTRACT

**Objective:** To examine risk factors associated with use of e-cigarettes only, conventional cigarettes only, and dual use in Korean adolescents and young adults.

**Methods:** In a cross-sectional study, anonymous questionnaires were completed between April–May, 2015 among 1) 2744 middle and high school students, aged 13–18, from Seoul, Incheon, Gyeonggi, and Cheongju, Korea and 2) 2167 university students, aged 19–29, from fourteen universities in Korea.

**Results:** The results show that 12.6% of adolescents and 21.2% of university students reported having ever tried e-cigarettes at least once. Among the ever e-cigarette users, 95.1% and 96.3% of adolescents and university students also tried conventional cigarettes, respectively. Dual users were more likely to be male (adolescents: OR 2.63, 95% CI 1.93–3.57; university students: 4.28, 3.21–5.70), have any close friends who smoke (adolescents: 11.56, 7.63–17.53; university students: 11.29, 5.52–23.10), have any siblings who smoke (adolescents: 3.17, 2.25–4.46; university students: 1.78, 1.30–2.43), and have observed teachers smoke cigarettes at school (adolescents: 1.45, 1.05–2.01).

**Conclusions:** A majority of e-cigarette users were dual users. Friends' and siblings' smoking status were significantly associated with dual product use in adolescent and young adult populations. Surveillance of e-cigarette use and implementation of evidence-based behavioral interventions targeting adolescents and young adults are necessary.

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## 1. Introduction

Electronic cigarettes (or e-cigarettes) are battery-powered devices that generate an aerosol of vapor without combustion. The e-cigarette liquid (“e-liquid”) usually consists of a combination of propylene glycol and vegetable glycerine as the vehicle, with variable concentrations of nicotine and flavor additives (Etter and Bullen, 2011; WHO, 2009). Experimentation with and regular use of e-cigarettes is growing rapidly in some countries, particularly among adolescents and young adults. This epidemic rise is well documented in the United States (Singh et al., 2016), and some

prior studies show that e-cigarette use is also occurring in Korea, motivating the study that we report here (Lee et al., 2014).

Because e-cigarettes have only recently been widely used, the effects of e-cigarettes on human health have not yet been well characterized, but the products have been proposed as offering a harm reduction alternative to conventional, combusted cigarettes (Royal College of Physicians, 2016). The emergence of e-cigarettes may promote cigarette smoking reduction by substituting e-cigarettes for the biochemical and behavioral aspects of cigarette nicotine addiction (Brose et al., 2015), but empirical study of the harm reduction benefits of e-cigarettes has been limited. While e-cigarettes may prove useful for harm reduction, there is rising concern that these products will introduce adolescents and young adults to nicotine and lead to dual use with conventional cigarettes, and possibly to regular use of cigarettes and nicotine addiction (Barrington-Trimis et al., 2015). Consequently, there is a need to

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track closely the use of e-cigarettes by adolescents and young adults.

To effectively educate and counsel individuals using multiple tobacco products, identification of factors associated with concurrent use is important; however, risk factors for e-cigarette use alone and dual use with conventional cigarettes have received limited attention to date, particularly in Korea. Therefore, the aim of this study is to explore and compare factors associated with e-cigarette use and with dual use in Korean adolescents and university students.

## 2. Methods

### 2.1. Participants

The study participants were recruited for the 2015 Yonsei Health Study, which included 2744 adolescents and 2167 university students. Adolescents aged 13–18 years voluntarily participated in the 20–40 min survey which was conducted in each classroom of middle and high schools located in Seoul, Incheon, Gyeonggi, and Cheongju, Korea. University students were volunteers aged 19 years and older who participated in the same survey conducted at 14 different university campuses located in Seoul, Gyeonggi, Gyeongbuk, Gyeongnam, Busan, Chungbuk, Daejeon, Jeonju, Gwangju, and Jeju Island. Middle and high schools and universities were approached and selected because of their diverse demographic characteristics. Adolescents from grade 7 to grade 12 and university students from year 1 to year 4 were included in the analysis. Survey questions were obtained from the Southern California Children's Health Study (CHS) survey questionnaire and the 2013 Global Youth Tobacco Survey (GYTS; [Barrington-Trimis et al., 2015](#); [WHO, 2013](#)). All schools and universities agreed to participate in the study.

### 2.2. Procedure

Each participant completed an anonymous, written questionnaire that was collected by research staff in the classroom. All participants provided written informed consent, approved by the Institutional Review Board for Human Research at Yonsei University (No.4-2015-0078). Each student was given \$5 worth of stationery supplies after completion of the survey.

### 2.3. Measures

Lifetime use of conventional or electronic cigarettes was assessed by asking "Have you ever used cigarettes/e-cigarettes in your life?" (yes/no). Current use of conventional or e-cigarettes was assessed by asking "During the last 30 days, have you used conventional/electronic cigarettes?" (yes/no). Participants who concurrently or ever used both conventional and e-cigarettes were classified as dual users. Smoking of combustible cigarettes by parents, siblings, and peers was assessed for each participant by asking "Do any of your family members (father/mother/siblings/others) or your close friends smoke (none/a few/most/all)? Select all that apply." Adolescents were also asked whether they had seen school teachers smoking outdoors or on the school premises. Sociodemographic variables included age, gender, type of school (middle/high/university), and field of study. Prior to the survey, a pilot survey was conducted among 15 young adults, aged 20–29 years, working at Severance Hospital and 300 middle and high school students in Cheongju city, Korea to optimize the survey questions.

**Table 1**

Ever- and last 30 days of conventional cigarettes, e-cigarettes, and dual use among Korean adolescents and university students.

	N (%)		
	Total	Male	Female
Adolescents	2744 (100.0)	1496 (100.0)	1248 (100.0)
Ever use			
Never user	2246 (81.9)	1108 (74.1)	1138 (91.2)
Cigarette only user	153 (5.6)	109 (7.3)	44 (3.5)
E-cigarette only user	17 (0.6)	15 (1.0)	2 (0.2)
Dual user	328 (12.0)	264 (17.7)	64 (5.1)
Last 30 days use			
Never user	2441 (89.0)	1243 (83.1)	1198 (96.0)
Cigarette only user	130 (4.7)	103 (6.9)	27 (2.2)
E-cigarette only user	38 (1.4)	31 (2.1)	7 (0.6)
Dual user	135 (4.9)	119 (8.0)	16 (1.3)
University Students	2167 (100.0)	1166 (100.0)	1001 (100.0)
Ever use			
Never user	1363 (62.9)	560 (48.0)	803 (80.2)
Cigarette only user	345 (15.9)	229 (19.6)	116 (11.6)
E-cigarette only user	17 (0.8)	10 (0.9)	7 (0.7)
Dual user	442 (20.4)	367 (31.5)	75 (7.5)
Last 30 days use			
Never user	1656 (76.4)	735 (63.0)	921 (92.0)
Cigarette only user	356 (16.4)	300 (25.7)	56 (5.6)
E-cigarette only user	27 (1.3)	22 (1.9)	5 (0.5)
Dual user	128 (5.9)	109 (9.4)	19 (1.9)

### 2.4. Data analysis

The proportion pertaining to each study variable was compared across e-cigarette only users, conventional cigarette only users, and dual user groups. Multinomial logistic regression analyses were performed to assess the independent associations of e-cigarette only use, conventional cigarette only use, and dual use with factors related to ever-/current conventional or e-cigarette use among adolescents and university students. All statistical analyses were performed using SAS software version 9.2 (SAS Institute, Cary, NC), and  $P < 0.05$  was considered statistically significant.

## 3. Results

For adolescents and university students, the rates of conventional cigarette only use, e-cigarette only use, and dual use increased with increasing age and grade ([Fig. 1](#) and Supplementary Fig. S1 in the online version at DOI: <http://dx.doi.org/10.1016/j.drugalcdep.2016.08.636>).

[Table 1](#) presents findings on ever- and current use of conventional cigarettes only, e-cigarettes only, and dual use groups among the adolescents and the university students. A total of 2246 adolescents (81.9%) and 1363 (62.9%) university students had never smoked a conventional cigarette or used an e-cigarette. Among adolescent males, 7.3% and 1.0% had ever used cigarettes only and e-cigarettes only, respectively, compared with 19.6% and 0.9% of university students who had ever used cigarettes only and e-cigarettes only, respectively. About 12.0% of adolescents and 20.4% of university students reported having ever tried both conventional and e-cigarettes. University students who currently or ever used tobacco products were more likely to be exclusive conventional cigarette only users than e-cigarette only or dual users. Prevalence estimates of ever dual use of conventional and e-cigarettes were higher among male adolescents and university students (17.7% and 31.5%, respectively), compared to female students (5.1% and 7.5%, respectively).

[Table 2](#) summarizes the associations between factors potentially related to conventional cigarette only, e-cigarette only, and dual use among adolescents and university students. Both adoles-

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