Determinants of electronic cigarette use among Korean adolescents and university students

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Determinants of electronic cigarette use among Korean adolescents and university students

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This certifies that the Master's Thesis
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ABSTRACT

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(Directed by Professor Sun Ha Jee, PhD)

Introduction A wide range of electronic cigarettes (e-cigarettes) are on market. Only a few studies to date have concurrently examined factors associated with e-cigarette use among Korean adolescents and university students.

Objectives To evaluate conventional, e-cigarettes, and dual prevalence and factors associated with their use among Korean adolescents and university students.

Methods A cross-sectional study was performed from a paper-and-pencil survey of 13-18-year-old Korean adolescents (N=2,744) and 19-29-year-old

university students (N=2,167) in 2015. Data were collected in April, 2015 from middle and high schools located in Seoul, Kyunggi, In-cheon, and Cheongju, Korea, and from14 different university campuses located in Seoul, Kyung-gi, Kyung-buk, Kyung-nam, Busan, Chung-buk, Dae-jeon, Chun-ju, Kwang-ju, and Jeju island. Socio-demographic variables included age, sex, educational level, and region of residence. Nicotine dependence and frequency of smoking were additionally assessed. Descriptive statistics and logistic regression analysis were used.

Results Approximately 12.6% and 21.18% of adolescents and university students, respectively, have ever experienced e-cigarettes. Having close friend who smoke was statistically significantly related to higher likelihood of using conventional cigarettes, e-cigarettes, and dual use in both adolescents and university students. Adolescents who have seen their teachers smoke had 51% and 45% higher chance of using conventional cigarettes and dual use in life, respectively.

Conclusion The results of this study provide important information about beneficial effect of smoking cessation support for adolescent and university students. More efforts must be deployed to deal with contributing factors to smoking relapse.

Keywords: tobacco, cigarettes, electronic cigarettes, dual use, adolescents, university students

I. INTRODUCTION

A. Background

Electronic cigarette, also known as e-cigarettes, has been rapidly gaining ground on conventional cigarettes (Dockrell et al., 2013; CDC, 2013). Since 2007, the first year of its entrance to market place, a dramatic increase in e-cigarette sales has been shown (Pauly et al., 2007; Cobb et al., 2010). About three billion dollars were estimated to be spent on e-cigarettes in 2013, and such number may increase 17 times by 2030 (Zhu et al., 2014). The health effects of e-cigarettes have not been fully determined, and questions have been raised as to whether it is a new tool for smoking cessation or simply substituting for conventional cigarettes (McKee, 2013; WHO FCTC, 2014; Mejia et al, 2010). Opponents have argued that e-cigarette liquid ("e-liquid") contain small amounts of harmful substances (e.g. carcinogenic nitrosamines, glycol, etc.), and that little is known about the health effects of these products since only a limited number of data on e-cigarettes use are present at the global level for many countries (WHO FCTC, 2014).

E-cigarettes are an emerging concern of health professionals as different colors, shapes, and flavors of e-cigarettes are found to be strongly appealing to young people, especially adolescents (Kinnunen et al., 2014). A previous study has

reported that heavy marketing on e-cigarettes is directed towards young people (Yamin et al., 2010), and recent studies have demonstrated how smokers' sociodemographic characteristics, nicotine dependence, smoking behavior, and motivation and self-efficacy to quit are related to the likelihood of having ever used e-cigarettes as well as dual use (Lotrean, 2015; Hanewinkel et al., 2015). Current (past 30 days) use of e-cigarettes tripled from 2013 to 2014 among both middle and high school students in the US (middle school: 1.1 percent in 2013, 3.9 percent in 2014; high school: 4.5 percent in 2013, 13.4 percent in 2014) (Dockrell et al., 2013; Porter et al., 2015), and a recent study of Korean adolescents found that current and heavier cigarette smoking was associated with e-cigarette use (Lee et al., 2014). While e-cigarette prevalence has been increasing dramatically, not many studies which examine e-cigarette associated factors are present in Korea to date because their use is so recent (Grana et al., 2013). Therefore, additional epidemiologic studies for factors associated with adolescents' and university students' e-cigarette and dual use are necessary in Korean population to effectively educate and counsel individuals, to reinforce tobacco regulation, and to ultimately protect the public's health.

B. Objectives

To identify prevalence of e-cigarettes, conventional cigarettes, and dual use among Korean adolescents aged 13-18 years and university students aged 19-29 years.

To evaluate association of e-cigarette use with dependence on nicotine among daily smokers.

To examine risk factors of e-cigarettes similar to conventional smoking initiation.

II. MATERIALS AND METHODS

A. Study Framework

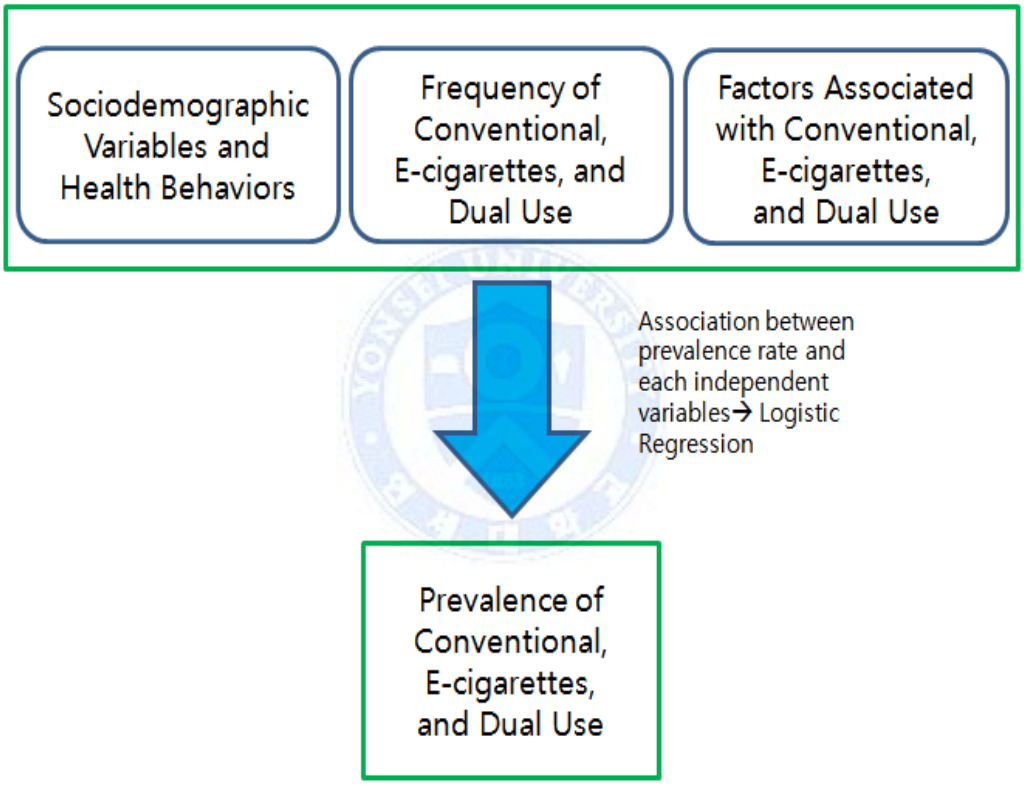

Figure 1. Study Framework

B. Study Population

i. Yonsei Health Study

The study subjects were recruited from the 2015 Yonsei Health Study on adolescents and university students. 2015 Yonsei Health Study uses a representative sample of 2,991 adolescents aged 13-18 years, who voluntarily participated in the 20-40 minutes survey conducted at each classroom of 4 middle and 8 high schools located in Seoul, Inchon, Kyung-gi, and Cheonju province, Korea; for young adults, a total of 2,480 university students aged 19-29 years, who voluntarily participated in the 20-40 minutes survey conducted at 14 different university campuses located in Seoul, Kyung-gi, Kyung-buk, Kyung-nam, Busan, Chung-buk, Dae-jeon, Chun-ju, Kwang-ju, and Jeju island were used.

A paper-based questionnaire was used to explore the subject's socio-demographic characteristics, smoking history, nicotine dependence (Fagerstrome test), factors associated with conventional, e-cigarettes, and dual use, product associated beliefs, etc. All subjects received a standardized program for smoking cessation including presentations or movie clips on harmful effects of smoking.

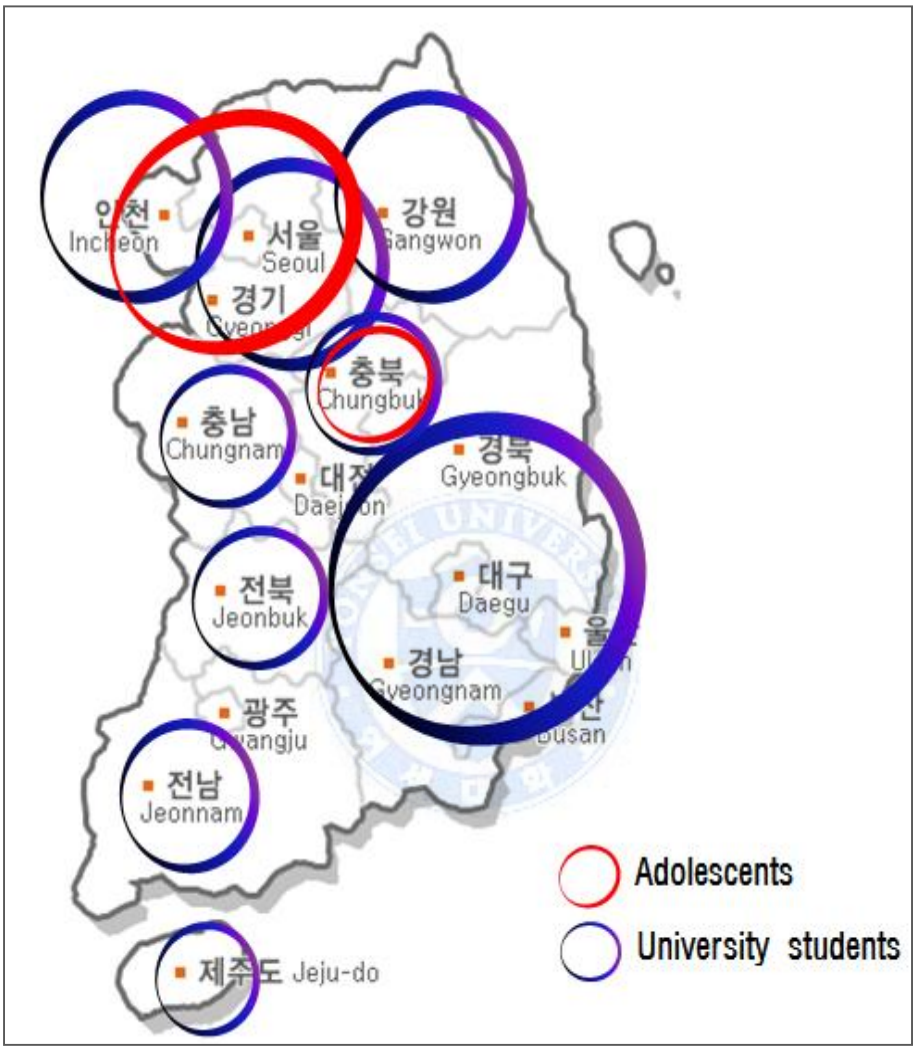

Figure 2. Study Regions

ii. Exclusion criteria

Subjects who were missing anthropometric data and written consents were excluded. Therefore, a total of 4,911 individuals (2,744 adolescents and 2,167 young adults) were determined as our final study subjects.

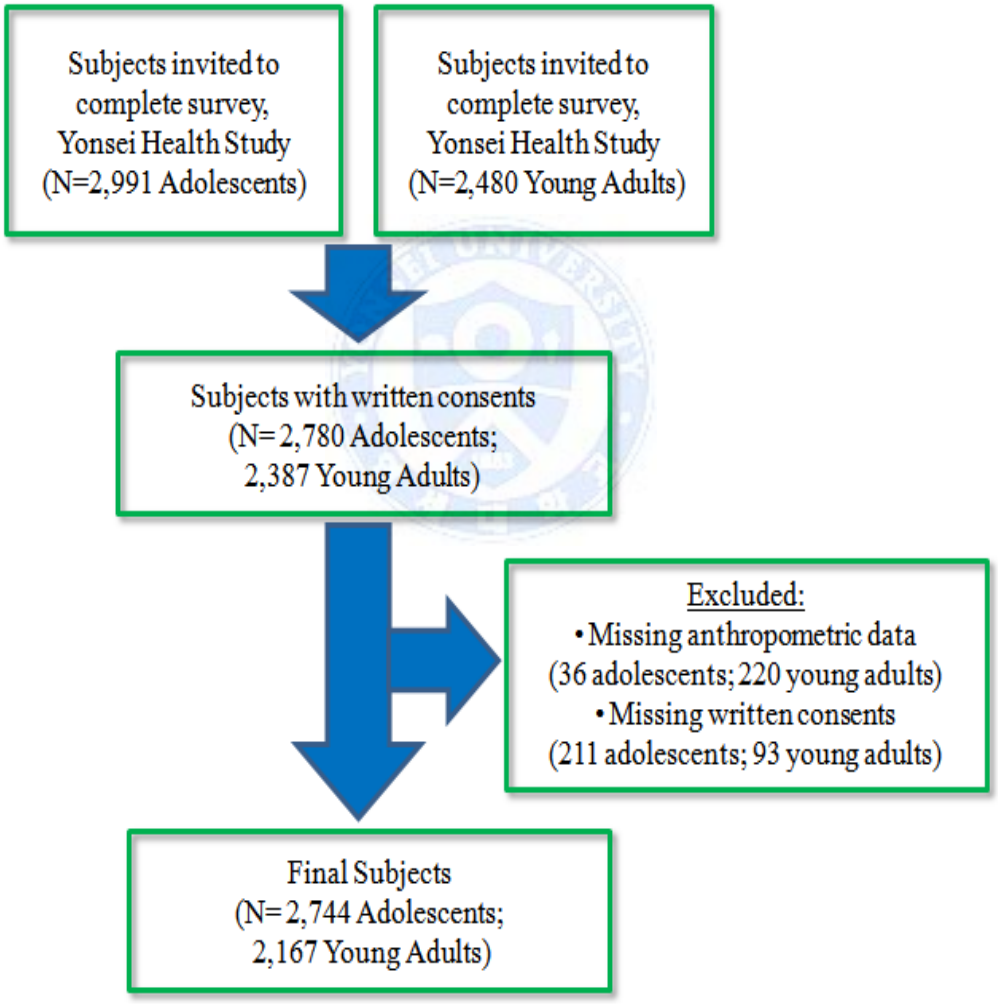

Figure 3. Participant Eligibility and Criteria for Study Inclusion

C. Methods

Questionnaires on various aspects of smoking were administered to all subjects. Data assessment was conducted by research staff in the classroom. To assure anonymity, written consent was obtained separately from the questionnaires, and all questionnaires were placed in an envelope which was sealed and returned to the researcher. For their participation, subjects were given less than ten dollars worth of stationery supplies.

i. Socio-demographic variables

Participants reported sex, age, level of education (dichotomized into "middle school" or "high school"), major for young adults, and region of residence. Participants' ages were categorized by grade as following: 7th graders for 13-year-old, 8th graders for 14-year-old, 9th graders for 15-year-old, 10th graders for 16-year-old, 11th graders for 17-year-old, and 12th graders for 18-year-old.

ii. Use of products for smoking cessation

Ever conventional and e-cigarettes uses were assessed by asking whether

the participants ever smoked any of them in life as following: “Have you ever used conventional/electronic cigarettes (even a puff)?” (yes/no). Recent use of conventional or e-cigarettes was assessed by asking “During the last 30 days, have you used conventional/electronic cigarettes?” (yes/no). Participants reporting both conventional and e-cigarette use were classified as dual users.

iii. Smoking, nicotine dependence, and quitting attitudes and behaviors

We measured cigarette consumption by asking participants the number of cigarettes they smoked per day on average in the past 30 days.

Based on a previous study (Pokhrel et al., 2013), participants who reported smoking 10 or fewer cigarettes on average per day were classified as “light smokers.” Participants were classified as “heavy smokers” if they reported smoking more than 10 cigarettes per day.

Parents, siblings, and peer conventional cigarette smoking were assessed for each participant. All adolescents replied whether they had seen the school faculty or teacher smoking.

We assessed nicotine dependence using the Fagerstrom Test of Nicotine Dependence, which has been used extensively in research during the past 20 years. Score 1-2: low dependence; 3-4: low to moderate dependence; 5-7: moderate

dependence; and 8+: high dependence.

Questions	Answers	Points
1. How soon after you wake up do you smoke your first cigarette	Within 5 minutes	3
	6-30 minutes	2
	31-60 minutes	1
	After 60 minutes	0
2. Do you find it difficult to refrain from smoking in places where it is forbidden e.g. in church, at the library, in cinema, etc.?	Yes	1
	No	0
3. Which cigarette would you hate most to give up?	The first one in the morning	1
	All others	0
4. How many cigarettes/day do you smoke?	10 or less	0
	11-20	1
	21-30	2
	31 or more	3
5. Do you smoke more frequently during the first hours after waking than during the rest of the day?	Yes	1
	No	0
6. Do you smoke if you are so ill that you are in bed most of the day?	Yes	1
	No	0

Figure 4. Scale of Fagerstrom Test of Nicotine Dependence (FTND) (Heatherton et al., 1991)

D. Statistical analysis

All statistical analyses were performed using SAS software version 9.2 (SAS Institute, Cary, NC), and $P<0.05$ were considered statistically significant. First, we computed descriptive statistics of key study variables separately by e-cigarette use status. The mean or proportion pertaining to each study variable was compared across e-cigarette user and nonuser groups. Next, to test the associations of socio-demographic and smoking- and cessation-related variables with ever having used e-cigarettes for cessation, we used multivariate logistic regression. This particular analytic approach enabled assessment of the effects of independent variables on ever having used e-cigarettes in terms of odds ratios, which in turn helped explain the nature and strength of the effects. We conducted regression analyses to test association of each demographic variable (i.e., age, gender, and education) with e-cigarette use, adjusting for other socio-demographic variables as covariates.

E. Ethics statement

All participants signed an informed consent form, which was approved by the Institutional Review Board for Human Research at Yonsei University (No.4-2015-0078).

III. RESULTS

A. General Characteristics of Study Population

Out analyses included 2,744 individuals aged 13-18 years, and 2,167 individuals aged 19-29 years. The general characteristics of all subjects are shown in Table 1a. Tables 1b~d summarize the participant characteristics by e-cigarette use status. Both ever and last 30 days users of e-cigarettes were adolescents in the 9th and 10th grades. The nicotine dependence scale of the e-cigarette users was low to moderate, but slightly higher than those who have not tried e-cigarettes. The ever- or last 30 days of e-cigarette use in university students ranged the highest in freshman year of college. University students tend to have a slight higher but moderate dependency on nicotine than adolescents.

Figures 5-8 show the prevalence rate of conventional, e-cigarettes, and dual use by sex among adolescents and university students. For men, all ever- or last 30 days use of conventional, e-cigarettes, and dual cigarettes showed the highest prevalence among 11th graders and 3rd grade university students, while 7th grade and 4th grade university students showed the lowest prevalence for all. Women, however, showed much lower prevalence for ever- or last 30 days use of conventional, e-cigarettes, and dual cigarettes when compared to men. Unlike men, 10th grade and 2nd grade university students showed the highest prevalence for ever use of all three types.

Table 1a. Number of study subjects by school year, adolescents and university students (N=4,611)

N (%)

Year (Middle/High/Univ.)	Middle School (N=1,040)			High School (N=1,704)			University (N=2,167)		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
7th / 10th / 1st	152	131	283	348	265	613	239	256	495
8th / 11th / 2nd	175	169	344	246	219	465	350	298	648
9th / 12th / 3rd	209	204	413	366	260	626	317	241	558
- / - / 4th	-	-	-	-	-	-	260	206	466
Total	536	504	1,040	960	744	1,704	1,166	1,001	2,167

Adolescents=2,744

Figure 5. Prevalence of ever e-cigarette, dual, and conventional cigarettes use by school year among adolescents and university students, men

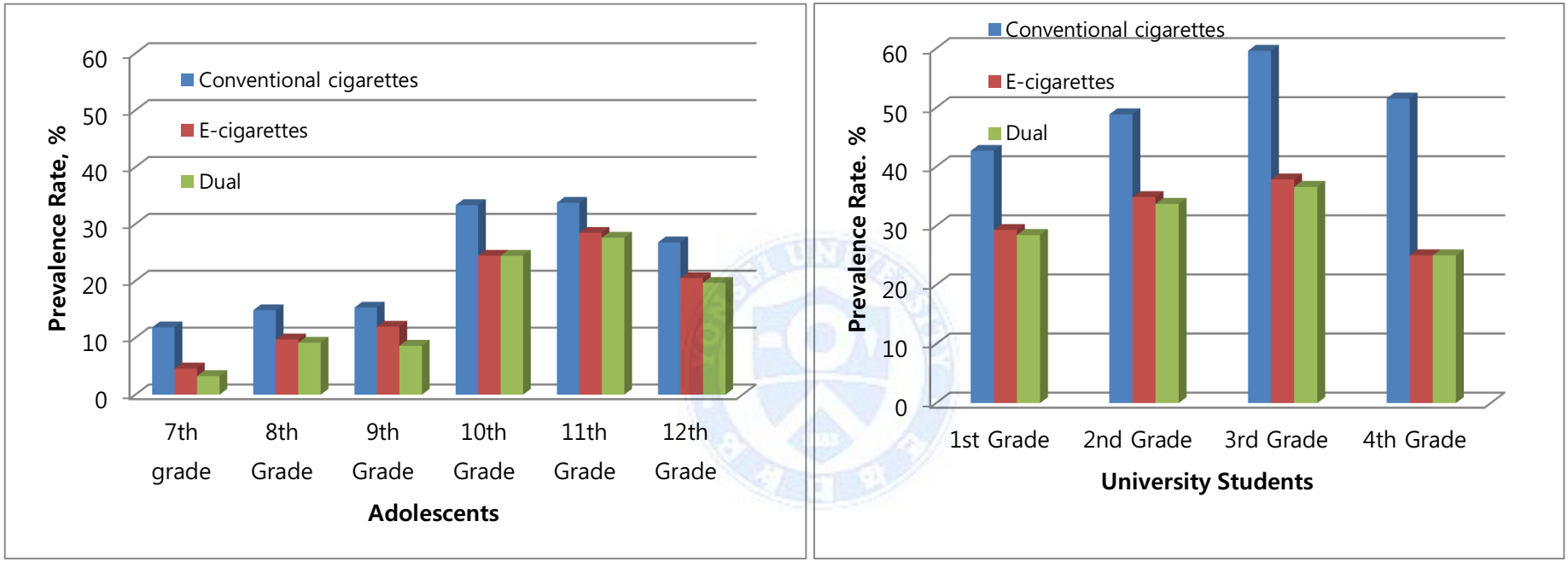

Figure 6. Prevalence of ever e-cigarette, dual, and conventional cigarettes use by school year among adolescents and university students, women

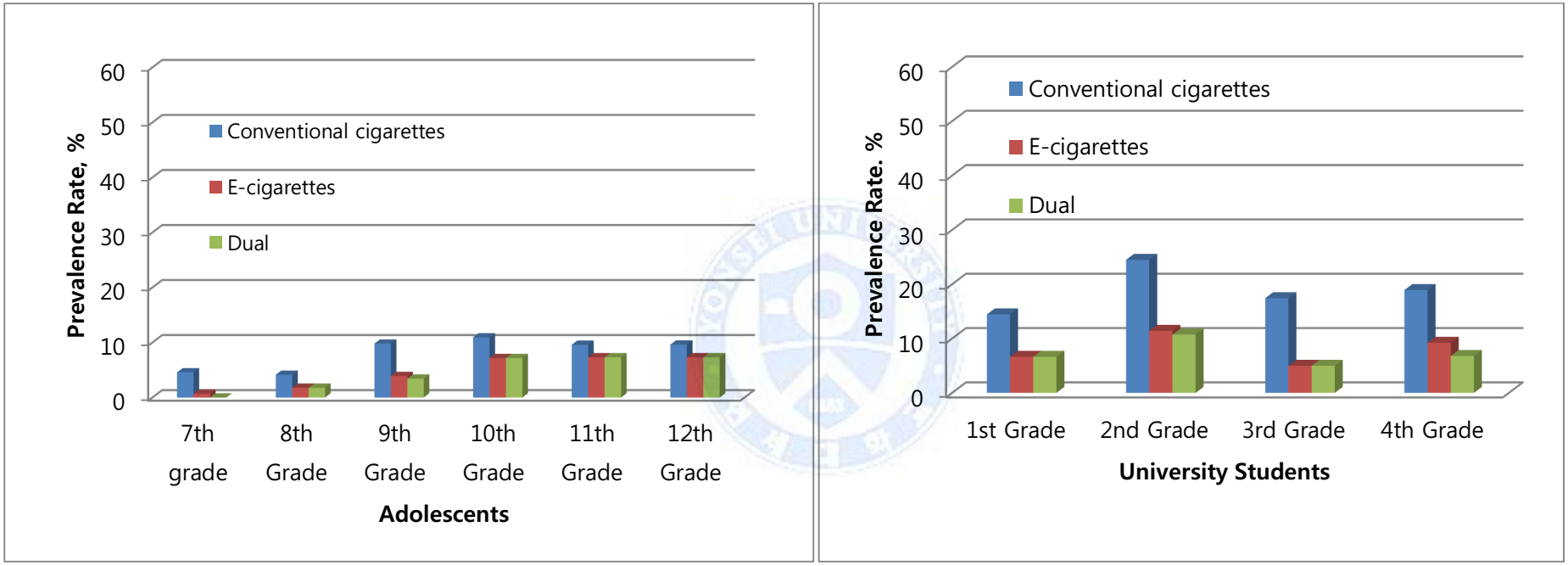

Figure 7. Prevalence of last 30 days use of e-cigarette, dual, and conventional cigarettes by school year among adolescents and university students, men

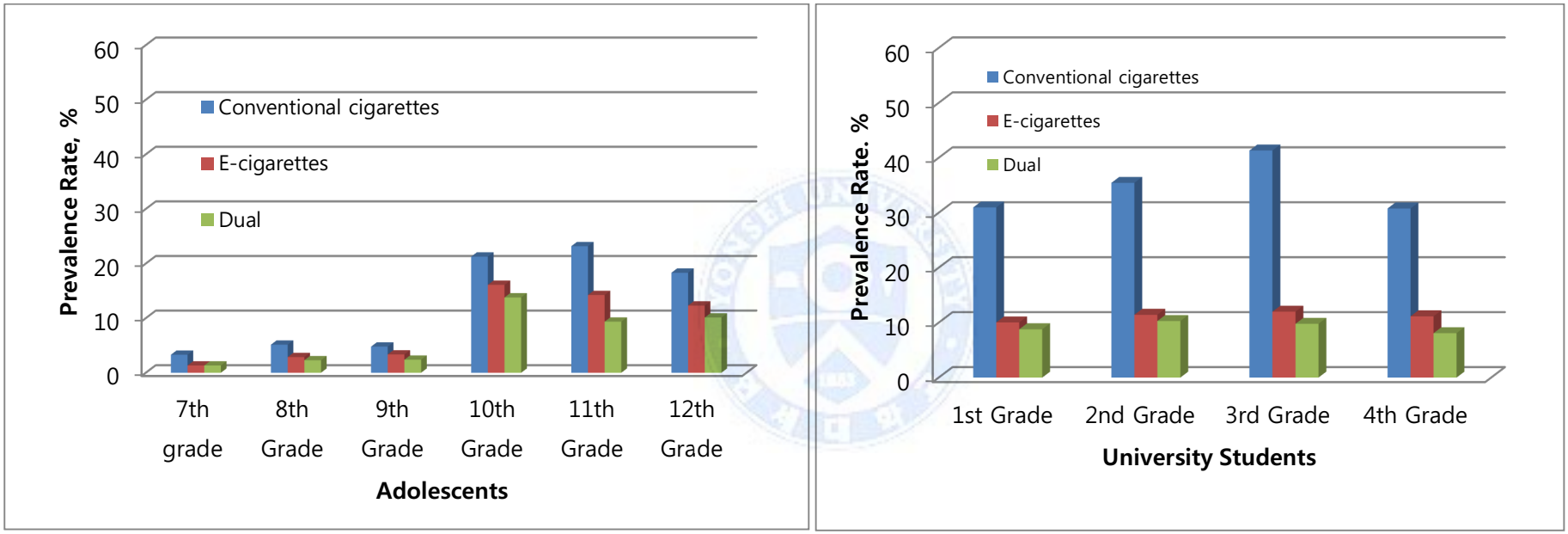

Figure 8. Prevalence of last 30 days use of e-cigarette, dual, and conventional cigarettes by school year among adolescents and university students, women

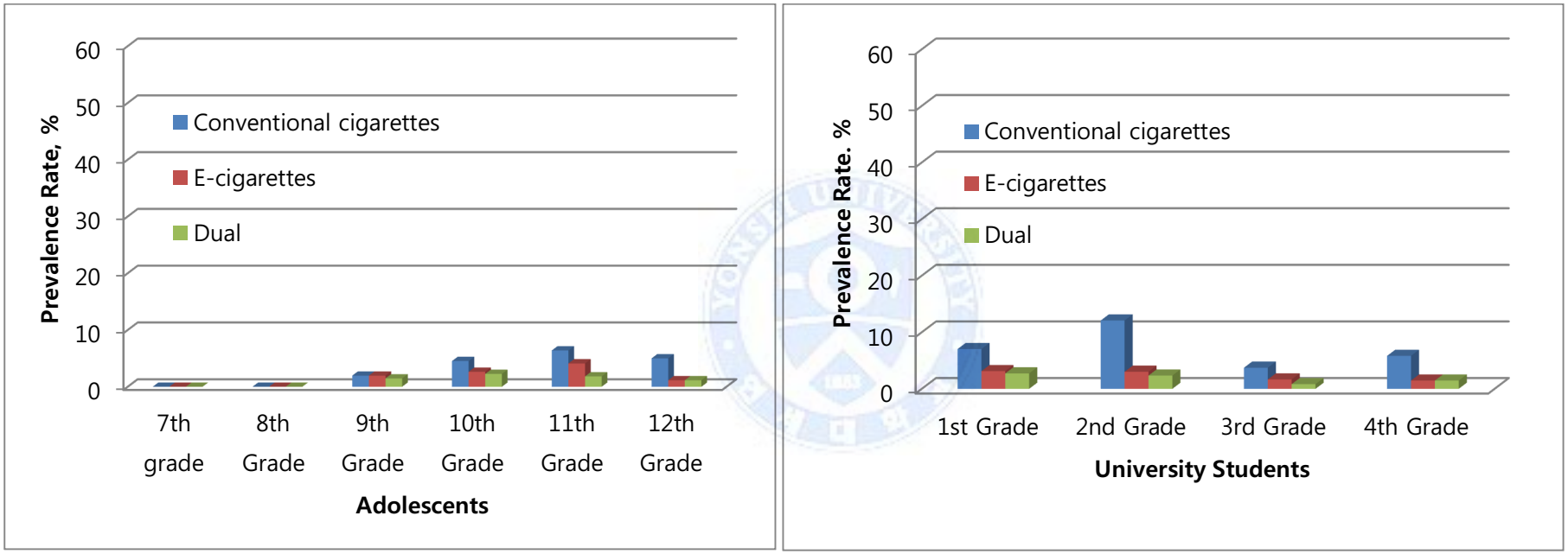

Table 1b. Demographic and smoking- and cessation-related characteristics of study subjects by ever e-cigarette use status, adolescents (N=2,744)

Characteristics	Total	Ever E-cigarette Users (N=345)	E-cigarette Nonusers (N=2,399)
	N	N (%) or Mean±SD	N (%) or Mean±SD
Grade, year			
7th grade	465	17 (4.93)	448 (18.67)
8th grade	418	32 (9.28)	386 (16.09)
9th grade	485	67 (19.42)	418 (17.42)
10th grade	542	89 (25.80)	453 (18.88)
11th grade	549	84 (24.35)	465 (19.38)
12th grade	285	56 (16.23)	229 (9.55)
Gender			
Male	1496	279 (80.87)	1217 (50.73)
Female	1248	66 (19.13)	1182 (49.27)
Education			
Middle School	1040	61 (17.68)	979 (40.81)
High School	1704	284 (82.32)	1420 (59.19)
Region of residence			
Seoul	361	17 (4.93)	344 (14.34)
Kyunggi do	779	37 (10.72)	742 (30.93)
In-cheon	715	103 (29.86)	612 (25.51)
Cheongju	889	188 (54.49)	701 (29.22)
Ever conventional cigarettes			
Non smoker		99 (28.70)	1277 (53.23)
Light smoker		126 (36.52)	586 (24.43)
Heavy smoker		120 (34.78)	536 (22.34)
Nicotine dependence (Fagerstrom)		5.85±1.87	5.38±1.45
Urge to smoke first cigarettes after waking up, minutes			
≤5		24 (6.96)	108 (4.50)
6-30		72 (20.87)	455 (18.97)
31-60		72 (20.87)	484 (20.18)
>60 or no response		177 (51.30)	1352 (56.36)
Difficult to refrain from smoking in forbidden places (Yes)		214 (62.03)	942 (39.27)
Hate to give up smoking in the morning (Yes)		114 (33.04)	771 (32.14)
Cigarettes smoking per day			
≤10		225 (65.22)	1863 (77.66)
11-20		38 (11.01)	228 (9.50)
21-30		25 (7.25)	121 (5.04)
> 60		57 (16.52)	187 (7.79)
Smoke more frequently in the morning (Yes)		42 (12.17)	136 (5.67)
Smoke even when sick in bed (Yes)		91 (26.38)	520 (21.68)

Abbreviations: SD, standard deviation;

Continuous variables are presented as mean±standard deviation(SD); Light smokers smoked ≤10 cigarettes on average daily.

Fagerstrom Test of Nicotine Dependence (range = 0–10).

Table 1c. Demographic and smoking- and cessation-related characteristics of study subjects by last 30 days e-cigarette use status, adolescents (N=2,744)

Characteristics	Total	Last 30 Days E-cigarette Users (N=173)	E-cigarette Nonusers (N=2,571)
	N	N (%) or Means±SD	N (%) or Means±SD
Age			
7th grade	465	3 (1.73)	462 (17.97)
8th grade	418	11 (6.36)	407 (15.83)
9th grade	485	41 (23.70)	444 (17.27)
10th grade	542	48 (27.75)	494 (19.21)
11th grade	549	43 (24.86)	506 (19.68)
12th grade	285	27 (15.61)	258 (10.04)
Gender			
Male	1496	150 (86.71)	1346 (52.35)
Female	1248	23 (13.29)	1225 (47.65)
Education			
Middle School	1040	18 (10.40)	1022 (39.75)
High School	1704	155 (89.60)	1549 (60.25)
Region of residence			
Seoul	361	5 (2.89)	356 (13.85)
Kyunggi do	779	26 (15.03)	753 (29.29)
In-cheon	715	50 (28.90)	665 (25.87)
Cheongju	889	92 (53.18)	797 (31.00)
Current conventional cigarettes			
Non smoker		14 (8.09)	1362 (52.98)
Light smoker		69 (39.88)	643 (25.01)
Heavy smoker		90 (52.02)	566 (22.01)
Nicotine dependence (Fagerstrom)		3.73±2.35	2.13±1.87
Urge to smoke first cigarettes after waking up, minutes			
≤5		18 (10.40)	114 (4.43)
6-30		49 (28.32)	478 (18.59)
31-60		38 (21.97)	518 (20.15)
>60 or no response		68 (39.31)	1461 (56.83)
Difficult to refrain from smoking in forbidden places (Yes)		99 (57.23)	1057 (41.11)
Hate to give up smoking in the morning (Yes)		65 (37.57)	820 (31.89)
Cigarettes smoking per day			
≤10		83 (47.98)	2005 (77.99)
11-20		34 (19.65)	232 (9.02)
21-30		14 (8.09)	132 (5.13)
> 60		42 (24.28)	202 (7.86)
Smoke more frequently in the morning (Yes)		25 (14.45)	153 (5.95)
Smoke even when sick in bed (Yes)		78 (45.09)	533 (20.73)

Abbreviations: SD, standard deviation;

Continuous variables are presented as mean±standard deviation(SD); Light smokers smoked ≤10 cigarettes on average daily. A total of 2241 subjects did not reply the cigarette smoke per day. Fagerstrom Test of Nicotine Dependence (range = 0–10).

Table 1d. Demographic and smoking- and cessation-related characteristics of study subjects by ever e-cigarette use status, university students (N=2,167)

Characteristics	Total	Ever E-cigarette Users (N=459)	E-cigarette Nonusers (N=1,708)
	N	N (%) or Means±SD	N (%) or Means±SD
Age			
<18-19 / 22	645 / 310	112 (24.40) /85 (18.52)	533 (31.21) / 225 (13.17)
20 / 23	381 / 270	58 (12.64) / 82 (17.86)	323 (18.91) / 188 (11.01)
21 /≥24	281 / 280	43 (9.37) / 79 (17.21)	238 (13.93) / 201 (11.77)
Gender			
Male	1166	337 (82.14)	789 (46.19)
Education			
Humanities	603	90 (19.82)	513 (30.23)
Science	1266	274 (60.35)	992 (58.46)
Art	282	90 (19.82)	192 (11.31)
Region of residence			
Seoul	197	35 (8.47)	162 (11.19)
Kyunggi do	360	76 (18.40)	284 (19.61)
Kangwon do	153	32 (7.75)	121 (8.36)
Chung-cheong do	148	34 (8.23)	114 (7.87)
Jeolla do	200	39 (9.44)	161 (11.12)
Kyungsang do	312	73 (17.68)	239 (16.51)
Je-ju island	79	10 (2.42)	69 (4.77)
Busan	412	114 (27.60)	298 (20.58)
Ever conventional cigarettes			
Non smoker		-	1 (0.06)
Light smoker		276 (60.13)	1235 (72.31)
Heavy smoker		183 (39.87)	472 (27.63)
Nicotine dependence		2.74±2.18	2.36±2.11
Urge to smoke first cigarettes after waking up, minutes			
≤5		71 (37.04)	250 (14.64)
6-30		127 (19.83)	448 (26.23)
31-60		91 (27.67)	307 (17.97)
>60 or no response		170 (15.47)	703 (41.16)
Difficult to refrain from smoking in forbidden places (Yes)		96 (20.92)	259 (15.16)
Hate to give up smoking in the morning (Yes)		146 (31.81)	421 (24.65)
Current cigarettes smoking per day			
≤10		276 (60.13)	1236 (72.37)
11-20		134 (29.19)	302 (17.68)
21-30		11 (2.40)	34 (1.99)
> 60		38 (8.28)	136 (7.96)
Smoke more frequently in the morning (Yes)		27 (5.88)	96 (5.62)
Smoke even when sick in bed (Yes)		160 (34.86)	526 (30.80)

Abbreviations: SD, standard deviation; Continuous variables are presented as mean±standard deviation(SD); Light smokers smoked ≤10 cigarettes on average daily. Fagerstrom Test of Nicotine Dependence (range = 0–10); Seoul and Busan: metropolitan city.

Table 1e. Demographic and smoking- and cessation-related characteristics of study subjects by last 30 days e-cigarette use status, university students (N=2,167)

Characteristics	Total	Last 30 Days E-cigarette Users (N=155)	E-cigarette Nonusers (N=2,012)
	N	N (%) or Means±SD	N (%) or Means±SD
Age			
<18-19 / 22	645 / 310	34 (21.94) /25 (16.13)	611 (30.37) / 285 (14.17)
20 / 23	381 / 270	22 (14.19) /27 (17.42)	359 (17.84) / 243 (12.08)
21 / ≥24	281 / 280	14 (9.03) /33 (21.29)	267 (13.27) / 247 (12.28)
Gender			
Male	1166	131 (84.52)	1035 (51.44)
Female	1001	24 (15.48)	977 (48.56)
Education			
Humanities	603	37 (24.03)	566 (28.34)
Science	1266	81 (52.60)	1185 (59.34)
Art	282	36 (23.38)	246 (12.32)
Region of residence			
Seoul	197	19 (13.38)	178 (10.35)
Kyunggi do	360	21 (14.79)	339 (19.72)
Kangwon do	153	13 (9.15)	140 (8.14)
Chung-cheong do	148	8 (5.63)	140 (8.14)
Jeolla do	200	10 (7.04)	190 (11.05)
Kyungsang do	312	25 (17.61)	287 (16.70)
Je-ju island	79	7 (4.93)	72 (4.19)
Busan	412	39 (27.46)	373 (21.70)
Current conventional cigarettes			
Non smoker		-	1 (0.05)
Light smoker		67 (43.23)	1444 (71.77)
Heavy smoker		88 (56.77)	567 (28.18)
Nicotine dependence		3.21±2.24	2.38±2.12
Urge to smoke first cigarettes after waking up, minutes			
≤5		27 (17.42)	294 (14.61)
6-30		40 (25.81)	535 (26.59)
31-60		35 (22.58)	363 (18.04)
>60 or no response		53 (34.19)	820 (40.76)
Difficult to refrain from smoking in forbidden places (Yes)		37 (23.87)	318 (15.81)
Hate to give up smoking in the morning (Yes)		54 (34.84)	513 (25.50)
Cigarettes smoking per day			
≤10		67 (43.23)	1445 (71.82)
11-20		60 (38.71)	376 (18.69)
21-30		6 (3.87)	39 (1.94)
> 60		22 (14.19)	152 (7.55)
Smoke more frequently in the morning (Yes)		9 (5.81)	114 (5.67)
Smoke even when sick in bed (Yes)		63 (40.65)	623 (30.96)

Abbreviations: SD, standard deviation; Continuous variables are presented as mean±standard deviation(SD); Light smokers smoked ≤10 cigarettes on average daily. Fagerstrom Test of Nicotine Dependence (range = 0–10); Seoul and Busan: metropolitan city.

B. Ever Use of Conventional and E-cigarettes

Table 2a-b presents ever use of conventional and e-cigarettes among adolescents and university students.

Participants who have tried both conventional and e-cigarettes in life showed an increase in proportion by age; adolescents in middle and high schools showed 4.71% and 16.37% for dual use, respectively, while university students showed the highest proportion ranging 20.40% (Tables 2a, 2b; Supplementary Tables 4, 6, 8).

A total of 345 (15.92%) of university students have ever tried conventional cigarettes only, while 17 (0.78%) have tried e-cigarettes only in life (Table 2b; Supple 8). The proportion of ever e-cigarettes use among university students was remarkably higher than adolescents (university students: 96.30%; adolescents: 12.57%), while ever conventional cigarettes use among adolescents doubled in university students.

Table 2a. Ever use of conventional and e-cigarettes, adolescents

Ever use of conventional cigarettes (N)	Ever use of e-cigarettes (N)		
	No	Yes	Total, N (%)
No	2,246	17	2,263 (82.47)
Yes	153	328	481 (17.53)
Total, N (%)	2,399 (87.43)	345 (12.57)	2,744 (100)

Table 2b. Ever use of conventional and e-cigarettes, university students

Ever use of conventional cigarettes (N)	Ever use of e-cigarettes (N)		
	No	Yes	Total, N (%)
No	1,363	17	1,380 (63.68)
Yes	345	442	787 (36.32)
Total, N (%)	1,708 (78.82)	459 (21.18)	2,167 (100)

C. Factors of Ever Conventional, E-cigarettes, and Dual Use

Table 3a-b presents the point estimates and corresponding 95% confidence intervals for adjusted odds ratios representing the associations between influential factors for smoking and ever conventional, e-cigarettes, and dual use. Having close friend who smoke was significantly related to higher likelihood of using conventional cigarettes, e-cigarettes, and dual use in both adolescents and university students. While adolescents who have any parents smoke showed no statistically significant associations with neither of the ever conventional, e-cigarettes, nor dual use, men and having any siblings smoke showed increased likelihood of ever having used any of those three variables. Adolescents who have seen their teachers smoke inside or outside the school had 51% and 45% higher chance of using conventional cigarettes and dual use in life, respectively.

When additionally adjusted for ever conventional cigarette use, adolescents who have close friends smoking showed odds ratio (OR) of 2.87 (CI, 1.76-4.68) and 4.02 (CI, 2.29-7.05) for those who have ever used e-cigarettes and dual cigarettes, respectively (Table 4). University students showed statistically significant but higher risks compared to adolescents (OR, CI: 4.03, 2.03-8.00 and 5.18, 2.34-11.45, respectively). Adolescents who have seen their siblings smoking had higher likelihood for ever experiencing e-cigarettes and dual use, while no statistically significant associations were shown for university students.

Table 3a. Factors associated with ever conventional, e-cigarettes, and dual use among adolescents

Variables	Ever cigarette Use (N=481)	Ever E-cigarette Use (N=345)	Ever Dual Use (N=328)
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Male (Female, ref.)	2.44 (1.90-3.13)	2.81 (2.08-3.79)	2.63 (1.93-3.57)
Age, year	1.11 (1.03-1.19)	1.20 (1.10-1.31)	1.24 (1.13-1.35)
Any close friends smoking	6.78 (5.11-8.99)	8.56 (5.94-12.35)	11.54 (7.61-17.51)
Any siblings smoking	2.87 (2.10-3.94)	3.32 (2.37-4.65)	3.22 (2.28-4.55)
Father smoking	1.21 (0.97-3.94)	1.15 (0.89-1.48)	1.10 (0.85-1.43)
Mother smoking	1.07 (0.66-1.74)	0.74 (0.41-1.33)	0.80 (0.44-1.43)
Teacher smoking	1.51 (1.15-1.99)	1.17 (0.82-1.66)	1.45 (1.05-2.01)

Adjusted for all variables in the table.

Table 3b. Factors associated with ever conventional, e-cigarettes, and dual use among university students

Variables	Ever cigarette Use (N=787)	Ever E-cigarette Use (N=459)	Ever Dual Use (N=442)
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Male (Female, ref.)	3.15 (2.53-3.92)	4.06 (3.07-5.37)	4.23 (3.17-5.65)
Age, year	1.13 (1.07-1.20)	1.02 (0.96-1.09)	1.03 (0.97-1.10)
Any close friends smoking	4.33 (3.10-6.04)	8.63 (4.65-16.00)	11.29 (5.52-23.11)
Any siblings smoking	2.12 (1.60-2.82)	1.74 (1.28-2.37)	1.78 (1.30-2.43)
Father smoking	1.32 (1.08-1.61)	1.25 (0.99-1.56)	1.26 (1.00-1.58)
Mother smoking	1.60 (0.91-2.84)	0.97 (0.49-1.92)	0.91 (0.45-1.84)

Adjusted for all variables in the table.

Table 4. Relationship between ever use of e-cigarettes and dual use in Korean adolescents and university students

Variables	Adolescents		University Students	
	Ever E-cigarette Use (N=345)	Ever Dual Use (N=328)	Ever E-cigarette Use (N=459)	Ever Dual Use (N=442)
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Ever smoked a conventional cigarette	175.80 (103.69-298.06)	>999.99	76.25 (45.95-126.54)	>999.99
Male (Female, ref.)	1.86 (1.21-2.85)	1.52 (0.94-2.46)	2.45 (1.73-3.48)	2.52 (1.74-3.67)
Age (per year)	1.24 (1.08-1.41)	1.35 (1.17-1.57)	0.92 (0.85-0.99)	0.92 (0.84-0.99)
Any close friends smoking	2.87 (1.76-4.68)	4.02 (2.29-7.05)	4.03 (2.03-8.00)	5.18 (2.34-11.45)
Any siblings smoking	2.18 (1.76-4.68)	1.94 (1.10-3.43)	1.15 (0.79-1.68)	1.15 (0.77-1.70)
Parents smoking				
Father	1.04 (0.71-1.53)	0.97 (0.64-1.47)	1.12 (0.84-1.49)	1.13 (0.84-1.53)
Mother	0.51 (0.23-1.14)	0.56 (0.24-1.33)	0.61 (0.28-1.33)	0.53 (0.24-1.19)
Teacher smoking	0.98 (0.62-1.57)	1.04 (0.62-1.75)	-	-

Adjusted for all variables in the table.

D. Last 30 days Use of Conventional and E-cigarettes

Table 5a-b presents the last 30 days use of conventional and e-cigarettes among adolescents and university students.

Similar to the “ever use” of the previous tables, participants who have tried both conventional and e-cigarettes during the last 30 days showed an increase in proportion by age; adolescents in middle and high schools showed 1.35% and 7.10% for dual use, respectively, while university students showed slightly lower proportion ranging 5.91% (Tables 5a, 5b; Supplementary Tables 5, 7, 9).

A total of 356 (16.43%) of university students have ever tried conventional cigarettes only, and 27 (1.25%) have tried e-cigarettes only during the last 30 days (Table 5b; Supplementary table 9). However, unlike the results obtained from the “ever use,” only a small difference was shown between the proportions of the “last 30 days” e-cigarettes use among adolescents and university students (university students: 6.30%; adolescents: 7.15%). The last 30 days use of conventional cigarettes, however, showed a significantly higher prevalence for university students than adolescents (adolescents: 9.66%; university students: 22.34%).

Table 5a. Last 30 days use of conventional and e-cigarettes, adolescents

Last 30 days use of conventional cigarettes (N)	Last 30 days use of e-cigarettes (N)		
	No	Yes	Total, N (%)
No	2,441	38	2,479 (90.34)
Yes	130	135	265 (9.66)
Total, N (%)	2,571 (93.70)	173 (6.30)	2,744 (100)

Table 5b. Last 30 days use of conventional and e-cigarettes, university students

Last 30 days use of conventional cigarettes (N)	Last 30 days use of e-cigarettes (N)		
	No	Yes	Total, N (%)
No	1,656	27	1,683 (77.66)
Yes	356	128	484 (22.34)
Total, N (%)	2,012 (92.85)	155 (7.15)	2,167 (100)

E. Factors of Last 30 days Conventional, E-cigarettes, and Dual Use

Table 6a-b presents the point estimates and corresponding 95% confidence intervals for adjusted odds ratios representing the associations between influential factors for smoking and the last 30 days use of conventional, e-cigarettes, and dual use. Compared to the ever use, adolescents who used conventional, e-cigarettes, and dual cigarettes during the last 30 days have shown a strong, statistically significantly increased risk when they had any close friend or siblings smoking; adolescents, in fact, showed higher odds ratio for all three variables (last 30 days of conventional cigarettes: OR 11.70, CI 7.09-19.31; e-cigarettes: 12.73, 6.59-24.60; dual: 11.87, 5.68-24.80).

Being a male and having any siblings smoke were also factors statistically significantly associated with the use of three different tobacco smoking conditions in both adolescents and university students. Similar to the ever use, adolescents who have any parents smoke showed no statistically significant associations with neither ever conventional, e-cigarettes, nor dual use. Adolescents who have seen their teachers smoke inside or outside the school had about 70% higher chance of using e-cigarettes.

Table 7 exhibits the relationship between the last 30 days use of e-cigarettes and dual use after additionally adjusting for the conventional cigarettes

use during the last 30 days. As a result, having any close friend smoke (OR 5.17, 2.56-10.44) showed an association with the recent e-cigarette use in adolescents, while having father smoke increased the risk of the recent e-cigarette use by 67% in university students.

Table 6a. Factors associated with the last 30 days use of conventional, e-cigarettes, and dual use among adolescents

Variables	Last 30 days of cigarette Use (N=265)	Last 30 days of E-cigarette Use (N=173)	Last 30 days of Dual Use (N=135)
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Male (Female, ref.)	3.29 (2.30-4.72)	3.87 (2.43-6.15)	4.37 (2.53-7.54)
Age, year	1.27 (1.15-1.40)	1.22 (1.08-1.37)	1.19 (1.04-1.36)
Any close friends smoking	11.70 (7.09-19.31)	12.73 (6.59-24.60)	11.87 (5.68-24.80)
Any siblings smoking	3.74 (2.60-5.39)	3.08 (2.04-4.65)	4.03 (2.62-6.21)
Father smoking	1.24 (0.93-1.65)	1.12 (0.80-1.56)	1.12 (0.77-1.62)
Mother smoking	1.13 (0.62-2.05)	1.62 (0.86-3.06)	1.36 (0.66-2.80)
Teacher smoking	1.21 (0.79-1.86)	1.70 (1.11-2.61)	1.58 (0.98-2.52)

Adjusted for all variables in the table.

Table 6b. Factors associated with the last 30 days use of conventional, e-cigarettes, and dual use among university students

Variables	Last 30 days of cigarette Use (N=484)	Last 30 days of E-cigarette Use (N=155)	Last 30 days of Dual Use (N=128)
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Male (Female, ref.)	5.15 (3.86-6.89)	4.05 (2.52-6.52)	4.08 (2.41-6.90)
Age, year	1.06 (1.00-1.13)	1.06 (0.96-1.16)	1.02 (0.92-1.13)
Any close friends smoking	7.31 (4.11-12.98)	3.21 (1.47-7.05)	9.82 (2.39-40.35)
Any siblings smoking	2.41 (1.77-3.27)	1.64 (1.06-2.55)	1.94 (1.22-3.07)
Father smoking	1.19 (0.95-1.50)	1.71 (1.22-2.40)	1.60 (1.11-2.31)
Mother smoking	1.60 (0.85-3.01)	1.24 (0.47-3.23)	0.85 (0.26-2.81)

Adjusted for all variables in the table.

Table 7. Relationship between the last 30 days use of e-cigarettes and dual use in Korean adolescents and university students

Variables	Adolescents		University Students	
	Last 30 days of E-cigarette Use (N=173)	Last 30 days of Dual Use (N=135)	Last 30 days of E-cigarette Use (N=155)	Last 30 days of Dual Use (N=128)
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Last 30days of conventional cigarette use	29.78 (18.70-44.27)	>999.99	16.49 (10.32-26.33)	>999.99
Male (Female, ref.)	2.61 (1.54-4.44)	2.17 (1.08-4.36)	1.83 (1.08-3.11)	1.12 (0.61-2.07)
Age (per year)	1.11 (0.96-1.29)	0.93 (0.76-1.14)	1.02 (0.93-1.13)	0.97 (0.87-1.09)
Any close friends smoking	5.17 (2.56-10.44)	1.38 (0.52-3.67)	1.33 (0.57-3.07)	1.74 (0.38-8.10)
Any siblings smoking	1.51 (0.91-2.52)	1.75 (0.97-3.16)	1.07 (0.67-1.73)	1.05 (0.63-1.76)
Parents smoking				
Father	0.98 (0.66-1.46)	0.88 (0.54-1.46)	1.67 (1.16-2.40)	1.51 (1.00-2.29)
Mother	1.89 (0.86-4.14)	0.43 (0.51-4.02)	1.09 (0.40-3.03)	0.57 (0.16-2.07)
Teacher smoking	1.23 (0.74-2.05)	0.74 (0.38-1.43)	-	-

Adjusted for all variables in the table.

Ⅳ. DISCUSSION

This is the first study in Korea to concurrently examine and compare e-cigarette use among adolescents and university students. Having close friends or siblings smoke was a strong factor associated with conventional, e-cigarettes, and dual use in both adolescents and university students, while more males than females reported ever e-cigarette use in both adolescents and university students (middle school: males, 9.14%; females, 2.38; high school: males, 23.96%; females, 7.26%; university: males, 32.33%; females, 8.19%). The comparison between the ever- versus the last 30 days of conventional, e-cigarettes, and dual use showed a dramatically higher dual use rates, ranging 20.40%, among university students who ever smoked in life, compared to those who used both products during the last 30 days (5.91%); a similar, but weaker trend was shown for both middle and high school students.

As e-cigarettes are relatively new, data on its usage patterns are not abundant. However, a recent cross-sectional study of 480 Romanian university students has provided an evidence that among social influences, subjects who have friends who have tried e-cigarettes were more likely to experience e-cigarettes than those who have any family members smoke, and factors such as male gender and a conventional cigarette smokers were also strongly associated

with e-cigarette use (Lotrean, 2015). We found a very similar risk pattern for e-cigarette and dual users in our data set. In addition, factors for smoking conventional cigarettes identified in the present study-social factors- were in line with the literature (Hanewinkel and Isensee, 2015; Kuntz and Lampert, 2013). While e-cigarettes use among adults has been reported previously, studies on adolescents have been emerging in recent years. A cross-sectional school-based survey of a sample of 1,941 high school students with a mean age of 14.6 years, conducted in Hawaii has found a very large prevalence rate of e-cigarettes only use (17%) (Wills et al., 2015).

A cohort study of New Zealand from 2012 to 2014 has documented a substantial amount of increase of e-cigarette ever-use among adolescents from 7.9% in 2012 to 20.0% in 2014, and factors such as gender and close friends' smoking status were associated with their use (White et al., 2015). A previous study on Korean adolescents has reported that 9.4% have ever used e-cigarettes, 4.7% have smoked in the past 30 days, and 8.0% have ever used cigarettes and e-cigarettes concurrently (Lee et al., 2014). This verifies that ever e-cigarette users among Korean adolescents have substantially increased (about 20-fold) in three years as a previous cross-sectional study of 4,341 middle and high school students has reported that only 0.5% were ever e-cigarette users (Cho et al., 2011). A study on 10th graders Korean in 2014 had the highest e-cigarette use, while 12th graders had the highest conventional cigarette use (Lee et al., 2014). Our study showed that

the highest conventional, e-cigarettes, and dual use among 11th graders, showing a little shift within a year.

This study is subject to several limitations. First, obtaining the consent form from adolescents may have affected the unclear report and thus a smaller number of current smokers than the actual number. However, we made sure that subjects were fully informed of anonymity prior to the survey. Secondly, because this was a self-reported survey, findings were subject to recall bias; to minimize such negative effects, a research staff was present at the survey to answer any ambiguous questions or to help understand the definition of each question. Also, female subjects of our study may have underreported their smoking status, as smoking in Korean history was culturally unacceptable for women. Our results, however, have shown a similar trend to those previously reported.

Many countries are beginning to perceive the seriousness of e-cigarettes use among young people (Kaur et al., 2014), yet some including Korea regulate e-cigarettes that are marketed for therapeutic purposes only (US Court Appeals, 2010); e-cigarettes without medicinal claims are, thus, currently unregulated in countries like Korea. Therefore, to protect young generations from any adverse health effects by e-cigarette or dual use, further studies should additionally focus on determining factors such as, 1) awareness or attitudes toward e-cigarettes, 2) changes in smoking behaviors, and 3) preference for e-cigarettes flavors among Korean adolescents and university students.

Ⅴ. CONCLUSION

The current study adds to the limited and conflicting data of the association between e-cigarette use and behavioral pattern among Korean adolescents and university students. Given the concern of many that the increase in new e-cigarette users among young populations, especially among adolescents, who never have smoked could have negative effects on public health field, this study may support the need for regulatory action in preventing use of e-cigarette among young populations.

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APPENDIX

Supplementary Table 1. Smoking rates of study subjects by sex, middle school

N (%)

	Men					Women					Total				
	Total	Ever conventional	Last 30 days conventional	Ever e-cigaretts	Last 30 days e-cigaretts	Total	Ever conventional	Last 30 days conventional	Ever e-cigaretts	Last 30 days e-cigaretts	Total	Ever conventional	Last 30 days conventional	Ever e-cigaretts	Last 30 days e-cigaretts
1st Grade	152	18 (11.84)	5 (3.29)	7 (4.61)	2 (1.31)	131	6 (4.58)	0	1 (0.66)	0	283	24 (8.48)	5 (1.77)	8 (2.83)	2 (0.71)
2nd Grade	175	26 (14.86)	9 (5.14)	17 (9.71)	5 (2.86)	169	7 (4.14)	0	3 (1.78)	0	344	33 (9.59)	9 (2.62)	20 (5.81)	5 (1.45)
3rd Grade	209	32 (15.31)	10 (4.78)	25 (11.96)	7 (3.35)	204	20 (9.80)	4 (1.96)	8 (3.92)	4 (1.96)	413	52 (12.59)	14 (3.39)	33 (7.99)	11 (2.66)
Total	536	76 (14.18)	24 (4.48)	49 (9.14)	14 (2.61)	504	33 (6.55)	4 (0.79)	12 (2.38)	4 (0.79)	1,040	109 (10.48)	28 (2.69)	61 (5.87)	18 (1.73)

Supplementary Table 2. Smoking rates of study subjects by sex, high school

N (%)

	Men					Women					Total				
	Total	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes	Total	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes	Total	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes
1st Grade	348	116 (33.33)	74 (21.26)	85 (24.43)	56 (16.09)	265	29 (10.94)	12 (4.53)	19 (7.17)	7 (2.64)	613	145 (23.65)	86 (14.03)	104 (16.97)	63 (10.28)
2nd Grade	246	83 (33.74)	57 (23.17)	70 (28.46)	35 (14.23)	219	21 (9.59)	14 (6.39)	16 (7.31)	9 (4.11)	465	104 (22.37)	71 (15.27)	86 (18.49)	44 (9.46)
3rd Grade	366	98 (26.78)	67 (18.31)	75 (20.49)	45 (12.30)	260	25 (9.62)	13 (5.00)	19 (7.31)	3 (1.15)	626	123 (19.65)	80 (12.78)	94 (15.02)	48 (7.67)
Total	960	297 (30.94)	198 (20.63)	230 (23.96)	136 (14.17)	744	75 (10.08)	39 (5.24)	54 (7.26)	19 (2.55)	1,704	372 (21.83)	237 (13.91)	284 (16.67)	155 (9.10)

Supplementary Table 3. Smoking rates of study subjects by sex, university

N (%)

	Men					Women					Total				
	Total	Ever conventional	Last 30 days conventional	Ever e-cigaretts	Last 30 days e-cigaretts	Total	Ever conventional	Last 30 days conventional	Ever e-cigaretts	Last 30 days e-cigarettes	Total	Ever conventional	Last 30 days conventional	Ever e-cigaretts	Last 30 days e-cigaretts
1st Grade	239	102 (42.68)	74 (30.96)	70 (29.29)	24 (10.04)	256	37 (14.45)	18 (7.03)	17 (6.64)	8 (3.13)	495	139 (28.08)	92 (18.59)	87 (17.58)	32 (6.46)
2nd Grade	350	171 (48.86)	124 (35.43)	122 (34.86)	40 (11.43)	298	73 (24.50)	36 (12.08)	34 (11.41)	9 (3.02)	648	244 (37.65)	160 (24.69)	156 (24.07)	49 (7.56)
3rd Grade	317	189 (59.62)	131 (41.32)	120 (37.85)	38 (11.99)	241	42 (17.43)	9 (3.73)	12 (4.98)	4 (1.66)	558	231 (41.40)	140 (25.09)	132 (23.66)	42 (7.53)
4th Grade	260	134 (51.54)	80 (30.77)	65 (25.00)	29 (11.15)	206	39 (18.93)	12 (5.83)	19 (9.22)	3 (1.46)	466	173 (37.12)	92 (19.74)	84 (18.03)	32 (6.87)
Total	1,166	596 (51.11)	409 (35.08)	377 (32.33)	131 (11.23)	1,001	191 (19.08)	75 (7.49)	82 (8.19)	24 (2.40)	2,167	787 (36.32)	484 (22.34)	459 (21.18)	155 (7.15)

Supplementary Table 4. Ever smoking rates of study subjects by sex, middle school

N (%)

	Men					Women					Total				
	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users
1st Grade	152	132 (86.84)	13 (8.55)	2 (1.32)	5 (3.29)	131	124 (94.66)	6 (4.58)	1 (0.76)	0	283	256 (90.46)	19 (6.71)	3 (1.06)	5 (1.77)
2nd Grade	175	148 (84.57)	10 (5.71)	1 (0.57)	16 (9.14)	169	162 (95.86)	4 (2.37)	0	3 (1.78)	344	310 (90.12)	14 (4.07)	1 (0.29)	19 (5.52)
3rd Grade	209	170 (81.34)	14 (6.70)	7 (3.35)	18 (8.61)	204	183 (6.37)	13 (6.37)	1 (0.49)	7 (3.43)	413	353 (85.47)	27 (6.54)	8 (1.94)	25 (6.05)
Total	536	450 (83.96)	37 (6.90)	10 (1.87)	39 (7.28)	504	469 (93.06)	23 (4.56)	2 (0.40)	10 (1.98)	1,040	919 (88.37)	60 (5.77)	12 (1.15)	49 (4.71)

Supplementary Table 5. Last 30 days smoking rates of study subjects by sex, middle school

N (%)

	Men					Women					Total				
	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users
1st Grade	152	147 (96.71)	3 (1.97)	0	2 (1.32)	131	131 (100.0)	0	0	0	283	278 (98.23)	3 (1.06)	0	2 (0.71)
2nd Grade	175	165 (94.29)	5 (2.86)	1 (0.57)	4 (2.29)	169	169 (100.0)	0	0	0	344	334 (97.09)	5 (1.45)	1 (0.29)	4 (1.16)
3rd Grade	209	197 (94.26)	5 (2.39)	2 (0.96)	5 (2.39)	204	199 (97.55)	1 (0.49)	1 (0.49)	3 (1.47)	413	396 (95.88)	6 (1.45)	3 (0.73)	8 (1.94)
Total	536	509 (94.96)	13 (2.43)	3 (0.56)	11 (2.05)	504	499 (99.01)	1 (0.20)	1 (0.20)	3 (0.60)	1,040	1,008 (96.92)	14 (1.35)	4 (0.38)	14 (1.35)

Supplementary Table 6. Ever smoking rates of study subjects by sex, high school

N (%)

	Men					Women					Total				
	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users
1st Grade	348	232 (66.67)	31 (8.91)	0	85 (24.43)	265	236 (89.06)	10 (3.77)	0	19 (7.17)	613	468 (76.35)	41 (6.69)	0	104 (16.97)
2nd Grade	246	161 (65.45)	15 (6.10)	2 (0.81)	68 (27.64)	219	198 (90.41)	5 (2.28)	0	16 (7.31)	465	359 (77.20)	20 (4.30)	2 (0.43)	84 (18.06)
3rd Grade	366	265 (72.40)	26 (7.10)	3 (0.82)	72 (19.67)	260	235 (90.38)	6 (2.31)	0	19 (7.31)	626	500 (79.87)	32 (5.11)	3 (0.48)	91 (14.54)
Total	960	658 (68.54)	72 (7.50)	5 (0.52)	225 (23.44)	744	669 (89.92)	21 (2.82)	0	54 (7.26)	1,704	1327 (77.88)	93 (5.46)	5 (0.29)	279 (16.37)

Supplementary Table 7. Last 30 days smoking rates of study subjects by sex, high school

N (%)

	Men					Women					Total				
	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users
1st Grade	348	266 (76.44)	26 (7.47)	8 (2.30)	48 (13.79)	265	252 (95.09)	6 (2.26)	1 (0.38)	6 (2.26)	613	518 (84.50)	32 (5.22)	9 (1.47)	54 (8.81)
2nd Grade	246	177 (71.95)	34 (13.82)	12 (4.88)	23 (9.35)	219	200 (91.32)	10 (4.57)	5 (2.28)	4 (1.83)	465	377 (81.08)	44 (9.46)	17 (3.66)	27 (5.81)
3rd Grade	366	291 (79.51)	30 (8.20)	8 (2.19)	37 (10.11)	260	247 (95.00)	10 (3.85)	0	3 (1.15)	626	538 (85.94)	40 (6.39)	8 (1.28)	40 (6.39)
Total	960	734 (76.46)	90 (9.38)	28 (2.92)	108 (11.25)	744	699 (93.95)	26 (3.49)	6 (0.81)	13 (1.75)	1,704	1433 (84.10)	116 (6.81)	34 (2.00)	121 (7.10)

Supplementary Table 8. Ever smoking rates of study subjects by sex, university

N (%)

	Men					Women					Total				
	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users
1st Grade	239	135 (56.49)	34 (14.23)	2 (0.84)	68 (28.45)	256	219 (85.55)	20 (7.81)	0	17 (6.64)	495	354 (71.52)	54 (10.91)	2 (0.40)	85 (17.17)
2nd Grade	350	175 (50.00)	53 (15.14)	4 (1.14)	118 (33.71)	298	223 (74.83)	41 (13.76)	2 (0.67)	32 (10.74)	648	398 (61.42)	94 (14.51)	6 (0.93)	150 (23.15)
3rd Grade	317	124 (39.12)	73 (23.03)	4 (1.26)	116 (36.59)	241	199 (82.57)	30 (12.45)	0	12 (4.98)	558	323 (57.89)	103 (18.46)	4 (0.72)	128 (22.94)
4th Grade	260	126 (48.46)	69 (26.54)	0	65 (25.00)	206	162 (78.54)	25 (12.14)	5 (2.43)	14 (6.80)	466	288 (61.80)	94 (20.17)	5 (1.07)	79 (16.95)
Total	1,166	560 (48.03)	229 (19.64)	10 (0.86)	367 (31.48)	1,001	803 (80.22)	116 (11.59)	7 (0.70)	75 (7.49)	2,167	1363 (62.90)	345 (15.92)	17 (0.78)	442 (20.40)

Supplementary Table 9. Last 30 days smoking rates of study subjects by sex, university

N (%)

	Men					Women					Total				
	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users	Total	Non smoker	Conventaional Cigarettes only	E-cigaretteses Only	Dual Users
1st Grade	239	162 (67.78)	53 (22.18)	3 (1.26)	21 (8.79)	256	237 (92.58)	11 (4.30)	1 (0.39)	7 (2.73)	495	399 (80.61)	64 (12.93)	4 (0.81)	28 (5.66)
2nd Grade	350	222 (63.43)	88 (25.14)	4 (1.14)	36 (10.29)	298	260 (87.25)	29 (9.73)	2 (0.67)	7 (2.35)	648	482 (74.38)	117 (18.06)	6 (0.93)	43 (6.64)
3rd Grade	317	179 (56.47)	100 (31.55)	7 (2.21)	31 (9.78)	241	230 (95.44)	7 (2.90)	2 (0.83)	2 (0.83)	558	409 (73.30)	107 (19.18)	9 (1.61)	33 (5.91)
4th Grade	260	172 (66.15)	59 (22.69)	8 (3.08)	21 (8.08)	206	194 (94.17)	9 (4.37)	0	3 (1.46)	466	366 (78.54)	68 (14.59)	8 (1.72)	24 (5.15)
Total	1,166	735 (63.04)	300 (25.73)	22 (1.89)	109 (9.35)	1,001	921 (92.01)	56 (5.59)	5 (0.50)	19 (1.90)	2,167	1,656 (76.42)	356 (16.43)	27 (1.25)	128 (5.91)

Supplementary Table 10. Ever- and last 30 days dual users among conventional cigarette users, middle school

N (%)

	Men		Women		Total	
	Ever dual users among ever conventional cigarettes smokers	Last 30 days dual users among last 30 days conventional cigarette smokers	Ever dual users among ever conventional cigarettes smokers	Last 30 days dual users among last 30 days conventional cigarette smokers	Ever dual users among ever conventional cigarettes smokers	Last 30 days dual users among last 30 days conventional cigarette smokers
1st Grade	5/18 (27.78)	2/5 (40.00)	0/6 0	0/0	5/24 (20.83)	2/5 (40.00)
2nd Grade	16/26 (61.54)	4/9 (44.44)	3/7 (42.86)	0/0	19/33 (57.58)	4/9 (44.44)
3rd Grade	18/32 (56.25)	5/10 (50.00)	7/20 (35)	3/4 (75)	25/52 (48.08)	8/14 (57.14)

Supplementary Table 11. Ever- and last 30 days dual users among conventional cigarette users, high school

N (%)

	Men		Women		Total	
	Ever Dual users among ever conventional cigarettes smokers	Last 30 days dual users among last 30 days conventional cigarette smokers	Ever dual users among ever conventional cigarettes smokers	Last 30 days dual users among last 30 days conventional cigarette smokers	Ever dual users among ever conventional cigarettes smokers	Last 30 days dual users among last 30 days conventional cigarette smokers
1st Grade	85/116 (73.28)	48/74 (64.86)	19/29 (65.52)	6/12 (50.00)	104/145 (71.82)	54/86 (62.79)
2nd Grade	68/83 (81.93)	23/57 (40.35)	16/21 (76.19)	4/14 (28.57)	84/104 (80.77)	27/71 (38.03)
3rd Grade	72/98 (73.47)	37/67 (55.22)	19/25 (76.00)	3/13 (23.08)	91/123 (73.98)	40/80 (50.00)

Supplementary Table 12. Ever- and last 30 days dual users among conventional cigarette users, university

N (%)

	Men		Women		Total	
	Ever Dual users among ever conventional cigarettes smokers	Last 30 days dual users among last 30 days conventional cigarette smokers	Ever dual users among ever conventional cigarettes smokers	Last 30 days dual users among last 30 days conventional cigarette smokers	Ever dual users among ever conventional cigarettes smokers	Last 30 days dual users among last 30 days conventional cigarette smokers
1st Grade	68/102 (66.67)	21/74 (28.38)	17/37 (45.95)	7/18 (38.89)	85/139 (61.15)	28/92 (30.43)
2nd Grade	118/171 (69.01)	36/124 (29.03)	32/73 (43.84)	7/36 (19.44)	150/244 (61.48)	43/160 (26.88)
3rd Grade	116/189 (61.38)	31/131 (23.66)	12/42 (28.57)	2/9 (22.22)	128/231 (55.41)	33/140 (23.57)
4th Grade	65/134 (48.51)	21/80 (26.25)	14/39 (35.90)	3/12 (25.00)	79/173 (45.66)	24/92 (26.09)

Supplementary Table 13. Fagerstrom score by sex among middle school students

N, Mean±SD

	Men				Women				Total			
	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes
1st	18 4.89±1.02	5 4.40±0.89	7 5.43±0.98	2 4.00±0.00	6 4.67±1.03	0 NA	1 4.00±0.00	0 NA	24 4.83±1.01	5 4.40±0.89	8 5.25±1.04	2 4.00±0.00
2nd	26 5.23±0.99	9 5.33±1.00	17 4.94±1.03	5 4.80±1.10	7 4.86±1.07	0 NA	3 5.33±1.15	0 NA	33 5.15±1.00	9 5.33±1.00	20 5.00±1.03	5 4.80±1.10
3rd	32 3.81±1.17	10 3.63±1.06	25 4.00±1.29	7 3.67±1.21	20 4.62±1.39	4 4.25±1.26	8 4.57±1.40	4 4.75±1.50	52 4.12±1.30	14 3.83±1.11	33 4.15±1.32	11 4.10±1.37
Total	76 4.68±1.21	24 4.50±1.22	49 4.60±1.26	14 4.15±1.14	33 4.69±1.19	4 4.25±1.26	12 4.73±1.27	4 4.75±1.50	109 4.68±1.20	28 4.46±1.21	61 4.63±1.25	18 4.29±1.21

Supplementary Table 14. Fagerstrom score by sex among high school students

N, Mean±SD

	Men				Women				Total			
	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes
1st	116 5.59±2.10	74 6.01±2.17	85 5.89±2.16	56 6.15±2.02	29 5.69±1.93	12 5.83±1.64	19 6.05±1.96	7 5.43±1.40	145 5.61±2.06	86 5.99±2.10	104 5.92±2.12	63 6.06±1.97
2nd	83 5.94±1.78	57 6.11±1.73	70 5.97±1.61	35 5.97±1.72	21 7.43±2.27	14 7.71±2.46	16 7.38±2.36	9 6.56±2.01	104 6.24±1.97	71 6.42±1.98	86 6.23±1.85	44 6.09±1.78
3rd	98 6.07±1.56	67 5.84±1.63	75 5.99±1.56	45 5.82±1.63	25 6.60±1.83	13 6.85±2.30	19 6.63±1.89	3 6.67±3.06	123 6.18±1.62	80 6.00±1.78	94 6.12±1.64	48 5.88±1.71
Total	297 5.85±1.85	198 5.98±1.87	230 5.95±1.81	136 5.99±1.81	75 6.48±2.09	39 6.85±2.27	54 6.65±2.09	19 6.16±1.95	372 5.98±1.92	237 6.12±1.96	284 6.08±1.88	155 6.01±1.83

Supplementary Table 15. Fagerstrom score by sex among university students

N, Mean±SD

	Men				Women				Total			
	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes	Ever conventional	Last 30 days conventional	Ever e-cigarettes	Last 30 days e-cigarettes
1st	102 5.74±2.31	74 5.88±2.28	70 5.76±2.30	24 5.08±2.59	37 5.51±2.08	18 5.50±2.38	17 5.94±2.54	8 4.38±2.13	139 5.68±2.24	92 5.80±2.29	87 5.79±2.33	32 4.91±2.47
2nd	171 5.11±2.14	124 4.91±2.21	122 5.03±2.07	40 5.03±1.77	73 5.22±2.26	36 5.75±2.44	34 5.29±2.61	9 5.44±2.60	244 5.15±2.17	160 5.10±2.28	156 5.09±2.20	49 5.10±1.93
3rd	189 5.02±2.02	131 5.14±2.01	120 5.21±2.01	38 5.24±2.06	42 5.57±2.65	9 4.44±2.55	12 5.17±3.54	4 4.00±2.94	231 5.12±2.15	140 5.09±2.05	132 5.20±2.17	42 5.12±2.14
4th	134 4.44±1.99	80 4.63±1.99	65 4.44±1.92	29 4.29±1.90	39 4.81±1.88	12 4.40±1.78	19 4.44±1.79	3 2.67±0.58	173 4.52±1.97	92 4.60±1.96	84 4.44±1.88	32 4.13±1.88
Total	596 5.04±2.13	409 5.11±2.15	377 5.12±2.10	131 4.94±2.06	191 5.28±2.25	75 5.34±2.38	82 5.22±2.60	24 4.50±2.40	787 5.10±2.16	484 5.14±2.19	459 5.14±2.20	155 4.87±2.11