



## Short Communication

## Electronic cigarette use and its association with smoking in Hong Kong Chinese adolescents

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## HIGHLIGHTS

- E-cigarettes use is increasing in adolescents.
- Association between e-cigarettes use and smoking in Chinese adolescents was less known.
- E-cigarettes use was associated with smoking intention in never, experimental and ex-smokers.
- E-cigarette use was associated with nicotine addiction in current smokers.

## ARTICLE INFO

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## ABSTRACT

**Background:** Electronic cigarettes (e-cigarettes) are increasingly used in adolescents with unknown impacts on conventional cigarette smoking. We examined the associations of e-cigarette use with smoking intention, nicotine addiction and smoking cessation in Chinese adolescents.

**Methods:** A total of 45,128 students (age  $14.6 \pm 1.9$ ; boys 51.4%) from 75 randomly selected schools in Hong Kong reported e-cigarette use (in the past 30 days), conventional cigarette use and socio-demographic characteristics in an anonymous questionnaire survey. Adjusted odds ratios (AORs) of intention to smoke, morning smoking urge, intention to quit and quit attempts; and beta-coefficient ( $\beta$ ) of cigarette consumption per day were calculated in relation to e-cigarette use.

**Results:** E-cigarette use was associated with intention to smoke with an AOR (95% CI) of 1.74 (1.30–2.31) in all students, 2.18 (1.12–4.23) in never and 2.79 (2.05–3.79) in ever smokers (non-significant interaction by smoking status). The associations were also significant in experimental and former smokers but not in current smokers. In current smokers, e-cigarette use was significantly associated with heavier smoking ( $\beta$  2.54, 95% CI 1.28–3.81) and morning smoking urge (AOR 2.54, 95% CI 1.50–3.11), and non-significantly associated with lower quit intention (0.76, 0.52–1.09) and attempts (0.80, 0.56–1.23).

**Conclusions:** E-cigarette use was associated with smoking intention in never, experimental and former smokers in Hong Kong Chinese adolescents. In current smokers, e-cigarette use was associated with nicotine addiction but not quit intention and attempts. Prospective studies with detailed measurements on e-cigarette use are warranted for further studies.

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## 1. Introduction

Electronic cigarettes (e-cigarettes) are highly controversial. Apparently, e-cigarettes have less toxicants than conventional cigarettes (Goniewicz et al., 2014) but acute adverse effects on respiratory function have been reported (Vardavas et al., 2012) and long-term health effects and abuse liability are uncertain. E-cigarettes are advocated as smoking cessation aids, but conflicting findings have been reported by

trials (Bullen et al., 2013; Caponnetto et al., 2013), longitudinal (Adkison et al., 2013; Grana, Popova, & Ling, 2014) and cross-sectional (Brown, Beard, Kotz, Michie, & West, 2015) studies. Some had argued that popular use of e-cigarettes may undermine tobacco control policies and renormalizes smoking (Fairchild, Bayer, & Colgrove, 2014). Young people might be particularly vulnerable to e-cigarette use as it is relatively new and seemingly safe (Durmowicz, 2014).

The prevalence of current e-cigarette use has reached 13.0% in Hungary (children aged 13–15), 8.2% in Poland (high school students), 4.5% in Korea (children aged 13–18) and 1.1% in the US (middle school students). Among smokers, one-fourth (26%) of US and 75% of Korean adolescent smokers were currently using e-cigarettes (Dutra & Glantz,

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2014; Lee, Grana, & Glantz, 2014). Cross-sectional studies among adolescents suggested that e-cigarette use was linked to heavier cigarette consumption and higher odds of smoking maintenance, but its associations with quit intention and attempts remain unclear (Dutra & Glantz, 2014; Lee et al., 2014; Lippert, in press). Some have advocated using e-cigarettes to lower smoking prevalence but the influence on smoking among never-smoking children is causing concern. Hong Kong, the most westernized and urbanized city of China with the strongest tobacco control measures and smoking denormalisation among Chinese cities, has the lowest smoking prevalence in the developed world (10.7% daily smoking in 2012–13) with decreasing smoking prevalence in adolescence (3.3% smoked in the past 30 days in 2012–13) (Mackay, Ritthiphakdee, & Reddy, 2013). We examined the associations of e-cigarette use with the intention to smoke, nicotine addiction and quitting in Hong Kong Chinese adolescents.

## 2. Methods

### 2.1. Study design and participants

A cross-sectional Youth Smoking Survey was conducted in 2012–13 in Secondary 1 (US grade 7) to 6 students (student response rate 96%) from 75 randomly selected schools (school response rate 20%). School sampling was stratified by district, mixed/single sex education, financial support, and school type. School non-responses were typically due to time and administrative issues, and the included schools were similar to all Hong Kong schools in district (Cohen's effect size 0.44), mixed/single sex education (0.13) and financial support (0.26). Sample representativeness was also supported by the small differences in sex (Cohen's effect size 0.04) and grade (0.01) distributions compared with the corresponding population in Hong Kong. Ethical approval was granted by a local institutional review board. An anonymous, self-administered questionnaire in Chinese adapted from the Global Youth Tobacco Survey (GYTS) (The GTSS Collaborative Group, 2006) was distributed to all classes in the selected schools. Completed answer sheets were collected by research staff immediately and sealed in opaque envelopes.

### 2.2. Measurement

As the first territory-wide school-based smoking survey to explore e-cigarette use, only one questions on e-cigarettes use in the past 30 days (yes vs no) was used. No levels of use were specified and students were expected to report any use including even 1 puff. Students were asked to selected their smoking status which was categorized as never smokers (even 1 puff), experimenters (ever smoked once or a few times), former smokers (smoked but quit) and current smokers (currently smoke non-daily or daily). Students reported whether they would smoke in the next 12 months, and when cigarettes were offered by one of their good friends in 2 separate items each with 4 response options of “definitely not”, “probably not”, “probably yes” and “definitely yes” (Sterling, Ford, Park, & McAlister, 2014). Those who chose “definitely not” for both questions were regarded as having no intention to smoke and otherwise as having an intention to smoke.

Nicotine addiction was assessed by 2 items. First, early morning smoking urge (morning smoking) was assessed with the question “Have you smoked or wanted to smoke first thing in the morning?” with 3 responses of “no”, “sometimes” and “always” with the latter two denoted morning smoking (Wang, Ho, Lo, & Lam, 2012). This single-item was accepted as a valid indicator of nicotine dependence (Baker et al., 2007). Second, students reported the number of cigarettes consumed in a day when smoking occurred in the past 30 days. Consuming more cigarettes (heavier smoking) is an essential feature of nicotine addiction (O'Loughlin et al., 2003). Quit attempts in the past 12 months (yes vs no), intention to quit (yes vs no), parental and peer smoking, sex, age, and proxies of socioeconomic status including

perceived family affluence (Ho et al., 2010), and parental education attainment were also reported by the students.

### 2.3. Statistical analysis

A total of 45,128 students remained after excluding 729 (1.6%) poorly answered questionnaires typically with over 50% missing data and dubious response patterns on the answer sheets. Descriptive data were weighted by sex and age distribution of the corresponding general population. Adjusted odds ratios (AORs) for intention to smoke by e-cigarette use in students with various smoking status were calculated using logistic regression adjusting for potential confounders and clustering effect of schools (to correct intra-class correlation errors). Similar methods were used for current smokers except linear regression which was used to study the association between e-cigarette use and heavier smoking.

## 3. Results

Among 45,128 students, 51.4% were boys, mean age was 14.6 ( $\pm 1.9$ ), 30.4% perceived family affluence as below average and 19.8% had paternal education below secondary school (data not shown in tables). The prevalence of e-cigarette use (past 30 days) was low overall (1.1%, 95% CI 1.0%–1.2%), but increased sharply with cigarette smoking status: never smokers 0.13%, experimenters 2.02%, former smokers 9.60% and current smokers 9.62% (Table 1). E-cigarette use was also more prevalent in students who reported an intention to smoke (4.1% vs 0.3%) and morning smoking (11.9% vs 6.0%) (both  $P < 0.001$ ). However, the prevalence of e-cigarette use was similar by intention to quit and quit attempt.

In all students, e-cigarette use was associated with intention to smoke with an AOR (95% CI) of 1.74 (1.30–2.31) adjusting for potential confounders and smoking status (Table 2). The corresponding AORs (95% CI) remained significant in never smokers (2.18, 1.12–4.23) and ever-smokers (2.79, 2.05–3.79) with non-significant interaction with smoking status ( $P = 0.45$ ). Further breakdown of ever-smoking status found significant AORs of smoking intention in experimenters (2.17, 1.32–3.62) and former smokers (1.48, 1.02–2.13) but a non-significant AOR in current smokers (1.25, 0.58–2.72). In current smokers, e-cigarette use was associated with higher levels of nicotine addiction with adjusted  $\beta$ -coefficient (95% CI) of 2.54 (1.28–3.81) for heavier smoking and AOR (95% CI) of 2.16 (1.50–3.11) for morning smoking. E-cigarette users were apparently less likely to have an intention to

**Table 1**  
Prevalence of e-cigarette use by smoking-related variables<sup>a</sup>.

	N (%)	E-cigarette use	
		% (95% CI)	$\chi^2$ P
All	45,128 (100%)	1.13 (1.04–1.23)	
Smoking status			
Never smokers	38,398 (85.0)	0.13 (0.10–0.17)	<0.001
Experimenters	3418 (7.6)	2.02 (1.54–2.55)	
Former smokers	1781 (3.9)	9.60 (8.27–11.06)	
Current smokers	1560 (3.5)	9.62 (8.20–11.18)	
Smoking intention			<0.001
No	36,541 (79.8)	0.34 (0.29–0.41)	
Yes	9238 (20.2)	4.12 (3.72–4.54)	
Current smokers			<0.001
Morning smoking urge			
No	597 (38.3)	5.98 (4.26–8.25)	
Yes	961 (61.7)	11.86 (9.89–14.08)	
Intention to quit			0.07
No	582 (48.0)	9.13 (6.90–11.74)	
Yes	631 (52.0)	7.20 (5.25–9.43)	
Quit attempts			0.17
No	533 (41.9)	9.29 (7.04–12.18)	
Yes	741 (58.1)	9.0 (7.00–11.19)	

<sup>a</sup> Weighted by sex and age distribution of the corresponding population.

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