Document heading doi: 10.21276/apjhs.2019.6.1.29 **Research Article**

The Profile of E-cigarette Users: Results of An Online Survey in Taiwan

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Abstract

E-cigarette is an emerging challenge for public health, including Taiwan. Our aim was to investigate the profiles of adulte-cigarette users in Taiwan, a country where there is currently very little information published about e-cigarette users. We conducted a cross-sectional, on-line, self-administered, and anonymous survey between July and November 2017. Participants (n=119)used e-cigarettes for almost two years on average, and used daily (84.9%), nicotine-containing e-cigarettes (74.8%), the average nicotine level was about 9 mg/ml. Smoking cessation and the perception of less harm were the main reasons for using e-cigarettes. Single users, compared with dual users, were more likely to endorse that "e-cigarette could help smoking cessation", and that "e-cigarettes are less toxic than combustible cigarettes."Our findings offer novel insights into the characteristic and behaviors of a specific sample of vapers in Taiwan, and can help generate hypotheses that can later be tested in representative samples of e-cigarette users.

Keywords: adult, dual users, e-cigarette, on-line survey, smoking cessation, user profiles.

Introduction

Studies have shown that e-cigarette use has recently increased in the USA[1], the UK[2], South Korea[3], Japan[4] and other countries. In Taiwan, e-cigarette user equires approval by drug regulatory authorities, and is not otherwise authorized. Violators are susceptible to heavy fines. At the time of this writing, no e-cigarette brand was approved for manufacture, importation, or sale by the Taiwanese Food and Drug Administration. Even though it is illegal, e-cigarette use has also increased in Taiwan[5]. In 2015,the Adult Smoking Behavior Survey found that 2.7% of respondents had tried e-cigarettes at least once[6], while the corresponding percentage was 2.2% in the National Substance Survey, conducted in 2014[7]. In the Taiwan Youth Tobacco Use Survey (TYTS), conducted in 2014 and again in 2016,the prevalence of current e-cigarette use were 2.0% and 3.7% among junior high school students, and 2.1% and 4.8% among senior high school students, respectively[5].

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Another study using TYTS data found that the rate of e-cigarette use over the preceding 30 days was 1.0% in 2014 and 2.1% in 2016, and the rate of dual use of e-cigarettes and combustible tobacco was 0.9% and 1.9%[8].E-cigarette use rates in Taiwan are relatively low in adults, relative to tobacco smoking, which decreased from 21.9% in 2008 to 17.1% in 2015[9].

In other countries, e-cigarette use is associated with gender[10-11], favorable perceptions of e-cigarettes in particular about their risk relative to smoking [12-13], smoking status[14], accessibility[13], curiosity[13,15], perception[16], and enjoyment, though vaping behavior and reasons for using e-cigarettes may change over time[17].Taiwan will join other countries regulating e-cigarettes[18] and is in the process of formulating regulations for e-cigarettes by modifying its Tobacco Hazards Control Act[19]. Our aim was to investigate the profiles of adult e-cigarette users in Taiwan, their beliefs about and reasons for using e-cigarettes, the perceived effectiveness of e-cigarettes for smoking cessation, and to compare e-cigarette users who quit smoking with those who continued to smoke. In Taiwan, there is currently very little information published about e-cigarette users. Our findings should allow for a better understanding of who e-cigarette users are, which may help in drafting e-cigarette regulations and education campaigns in Taiwan.

Materials and Methods

Design

Online surveys were already used to reach out to vapers[16,20].At the time of data collection, e-cigarette use was illegal in Taiwan, but promotional activities were found on the Internet, and Internet access rate is 80% in Taiwan[21]. Therefore, an on-line, self-administered, and anonymous survey was deemed appropriate to reach Taiwanese e-cigarette users in the context of a preliminary assessment of this group[22].We therefore conducted a cross-sectional online survey of e-cigarette users in Taiwan by postinga questionnaire, in Chinese, on the free-access smoking cessation website *Stop-tabac.ch* between July and November 2017. This website was managed by the second author. We then contacted discussion forums, websites that sell e-cigarettes, and vaper associations and asked them to publish links to the survey (www.stop-dependance.ch/tobacco/Ecig2017_tw/).

Participants

To be eligible, participants needed to be at least 20 years old and to currently reside in Taiwan. The survey was anonymous, voluntary and provided no economic or other incentives. After reading an online informed consent form and agreeing to participate, participants were directed to the questionnaire. The study was approved by the Research Ethics Committee of National Taiwan Normal University (201608HM005).

Measures

The online questionnaire had four sections.

Section1 assessed awareness of e-cigarettes. Section 2 assessed:

Age of first use, prior and current use of e-cigarettes, patterns of use, duration of current episode of use, nicotine content, puffs per day, e-liquid consumption (ml) per day, brand and model of e-cigarette, type of device, flavors, cost, source of purchase, and cigarette smoking.

Perceived effects of vaping on smoking cessation and reduction, satisfaction with e-cigarettes and whether they ever recommended e-cigarettes to other people.

Reasons for using e-cigarettes.

Reasons for discontinuing use, only among ex-users.

Tobacco smoking: age when they started smoking, current smoking, and reasons for smoking or not smoking.

Section 3 assessed participants' opinions one-cigarette regulations (reported separately).

Section 4 assessed socio-demographic characteristics: gender, age, education, region of residency, employment status, and monthly income.

Analysis

For analysis, we checked IP address, and retained only the 119 respondents (out of 269) who: (1) answered "Yes" to "have you ever used an e-cigarette?"(2) completed Sections 2 and 4 of the questionnaire. The remaining 150 respondents included 125 who had never used an e-cigarette, 21 who failed to provide information on their e-cigarette use, and 4 who reported having used e-cigarettes at least once, but had incomplete sociodemographic data. The data were summarized using descriptive statistics, including means with standard deviations and percentages.

In previous studies, one of the most cited reason for e-cigarette use is to quit or reduce tobacco cigarette smoking [13,23]. We then investigated the factors associated with current smoking status among Taiwanese e-cigarette users. Therefore, after this initial descriptive analysis, 13 of the 119were excluded from further analysis because they had never smoked cigarettes(n=5) or had already discontinued smoking cigarettes prior to using e-cigarettes(n=3), or were former e-cigarette users (n=5). The remaining 106current e-cigarette users were all cigarette smokers when they started to use e-cigarettes. These 106 participants were categorized either as being now either vapers exclusively (currently ex-smokers) or dual users (current users of both cigarettes and e-cigarettes), based upon their currently-reported smoking status. We were interested in examining the difference in socio-demographics and e-cigarette use behaviors between these two groups. For this, we used Pearson chi-square analysis to compare inter-group proportions, and Student's t tests for independent samples to compare means. All inferential tests were two-tailed, level of significance $p<0.05$.We used G*Power 3.1 to calculate statistical power[24].

Results

E-cigarette user profiles

Table 1 shows the characteristics, patterns of e-cigarette use, and smoking status of the 119e-cigarette users. They were mostly male (92.4%), young (mean = 29.9 years old), well-educated (65.5%had a university and 11.1% a post-graduate degree), employed (91.6%), and of low- to mid-level monthly income (62.2% had a monthly mean income <40,000NT$or about 1,330 USD). Roughly half of the participants resided in the northern, more urban part of Taiwan (47.9%).

Most e-cigarette users used them daily (84.9%); the remainder were either occasional (i.e. non-daily) users (9.2%) or former users (5.9%). Most used nicotine-

containing e-cigarettes (74.8%), the average reported nicotine level was 9.15 mg/mL, and the average duration of e-cigarette use 22 months. Subjects primarily used self-assembled devices or third-generation devices (85.5%) and bought their device and e-liquid mainly at e-cigarette shops (51.3% and 48.7%, respectively) or through websites (38.7% and 38.7%). Fruit (51.3%) and chocolate and sweet (20.2%) were the two flavors used most often.

Among these119 ever users of e-cigarette, 93.3% (n=111) were smokers at the time they initiated e-cigarette use, and eight were non-smokers (5 never smokers, and 3 former smokers). At the time of the survey, 58% (n=69) reported currently being non-smokers, while 42% (n=50) were current smokers. Most respondents (72.3%) reported having ever used, at some time, both e-cigarettes and combustible cigarettes concomitantly (dual use), most commonly (52.6%) to reduce their tobacco consumption, and many reported having quit smoking (58%).

Table 1: Characteristics of ever users of e-cigarettes, Taiwan, 2017 (N=119)

Socio-demographic variables		
Gender	Male	92.4%
Education level	University	65.5%
Region of residence	Northern Taiwan	47.9%
	Southern Taiwan	29.9%
	Others	22.2%
Employment	Currently employed	91.6%
Monthly income	<40,000NT$*	62.2%
Age	Mean (S.D.);Median 29.9(7.4); 28.0	
E-cigarette User Profiles		
Pattern of use	Daily	84.9%
E-cigarette device type	Self-assembled (3rd generation)	85.5%
Year of first use	2017	21.8%
	2016	25.2%
	2015	29.4%
	2014 and before	23.6%
Nicotine-containing	Yes	74.8%
E-liquid flavors	Fruit	51.3%
	Chocolate & sweet	20.2%
	Other	28.5%
Buy e-cig device/e-liquid, %	Vape shop	51.3/48.7
	Website	38.7/38.7
Length of use (months)	Mean (S.D.);Median 21.7 (21.9); 21	
Age at first use Mean (S.D.);Median (range 13~53years)	28.0 (7.5); 26.0	
Use days/week	Mean (S.D.);Median	
Averaged puffs/day	Mean (S.D.);Median	
Nicotine level (mg/mL)	Mean (S.D.);Median 9.1 (6.2); 9.0	
Expense (NT$): device	Mean (S.D.);Median 5,340(462); 3,100	
Expense (NT$): e-liquid /month	Mean (S.D.);Median 2,989 (792); 1,500	
Dual use: ever	Yes	72.3%
Dual use: reason	Reduce tobacco consumption	52.6%
Currently smoking status	Smoker (n=50)	42.0%
	Non-smoker (n=69)	58.0%

At initiation of e-cig use	Smoker (n=111) Former smokers (n=3) or never smoked (n=5)	93.3% 6.7%
*NT$ = Taiwanese dollars Note: The average monthly regular earnings per employee within the Industrial and Services sector in December 2016 was NT$39,729.		

Perceived effectiveness of, beliefs about and reasons for using e-cigarettes

Most participants (81.2%) claimed that e-cigarettes helped with smoking cessation, and 86.3% reported that they helped to reduce cigarette consumption. Most (92.4%) reported that they wanted to continue using e-cigarettes. When asked about their level of satisfaction with e-cigarettes on a scale ranging from zero (completely unsatisfied) to 10 (completely satisfied), the mean rating was 9.0. More than 90% had ever recommended e-cigarettes to some other person (Table 2).

When asked to compare e-cigarettes with combustible cigarettes: in terms of their nicotine level, addictiveness, harmfulness, and risks of second-hand smoke or vapors (Table 2) —most respondents felt that, relative to cigarettes, e-cigarettes had lower nicotine levels (53.8%) and were less addictive (59.8%). The vast majority felt that second-hand vapors from e-cigarettes are less harmful than second-hand cigarette smoke (93.0%), and that e-cigarettes are less harmful overall than cigarettes (87.2%).

The following were the top reasons given for using e-cigarettes: "e-cigarettes are less toxic than combustible cigarettes"(88.6%); "I like to use e-cigarettes"(86.8%);"I want to avoid bothering other people"(78.2%);"When I want to smoke, I use e-cigarettes instead"(77.2%); "I use e-cigarettes to replace tobacco cigarettes"(75.7%); and "I don't want to smell of smoke" (75.5%).

Table 2: Perceptions of e-cigarette effectiveness, beliefs and reasons for use among e-cigarette ever users (N_1=119), and current e-cigarette users who smoked at initiate use[a](N_2=106) by current smoking status

	Agree or totally agree, %			
		Current e-cigarette users[a] (N_2=106)		
	Ever users (N_1=119)	Single users (n_1=60)	Dual users[b] (n_2=46)	P value[c]
Perceived effectiveness of e-cigarettes				
Help smoking cessation	81.2	93.3	73.9	0.02*
Help reduce cigarette consumption	86.3	96.7	84.8	0.09
Will continue to use e-cigarettes	92.4	93.3	100.0	0.13
Self-rated Satisfaction Score: Mean (SD)	9.0(1.4)	9.3(1.1)	8.9(1.6)	0.06
Ever recommend e-cigarettes to>1 person	91.5	96.7	91.3	0.40
Beliefs comparing e- vs. combustible cigarettes				
E-cigarettes contain lower nicotine levels	53.8	55.9	50.0	0.83
E-cigarettes are less addictive	59.8	61.0	65.2	0.88
E-cigarettes are less harmful	87.2	93.2	80.4	0.07
E-cigarette "second-hand smoke" is less harmful	93.0	100.0	86.4	0.01*
Reasons for e-cigarette use				
E-cigarettes are less toxic than smoked cigarettes	88.6	96.7	81.0	0.01*
I like using e-cigarettes	86.8	93.3	83.3	0.27
I want to avoid bothering others	78.2	81.7	77.5	0.84
When I want to smoke, I use e-cigarettes	77.2	76.7	88.6	0.25
I use e-cigarettes to replace tobacco cigarettes	75.7	79.3	79.1	1.00
I don't want to smell of smoke	75.5	83.1	65.0	0.11

[a] Current e-cigarette users (N_2=106) who smoked at initiate of e-cigarette use, excluded 5 never smokers, 3 discontinued smoking cigarettes prior to using e-cigarettes, and 5 former e-cigarette users

[b] Current combustive cigarette smokers

[c]Comparison between "Single users" and "Dual users"

Comparing e-cigarette users who quit smoking with those who continued to smoke

Among the 106current e-cigarette users who also were smokers when they first started using e-cigarettes, 60reported having stopped smoking cigarettes and becoming vapers exclusively. We compared the seexclusive vapers (n=60) to those who continued to use both e-cigarettes and cigarettes (n=46) (Table 3).

Before they started using e-cigarettes, exclusive vapers smoked 15.4 conventional cigarettes daily, significantly less than dual users (21.2 conventional cigarettes per day, t=-3.18, p<0.01). Among dual users, cigarette consumption decreased from 21.2 cig/day before they started to vape to 7.3cigarettes daily currently (mean reduction 13.9 cig/day, 95% C.I. 11.0~16.8, t=9.7, p<0.01 by paired-samples t-test). In addition, the type of device differed between ex-smokers (single users), who used self-assembled device (93.2%) more often than current smokers (77.8%) (X^2=5.2, p= 0.04). More ex-smokers (single users) than dual users perceived that "E-cigarettes help smoking cessation" (93.3% vs 73.9%, p=0.02), believed that "E-cigarette second-hand vapor is less harmful than second-hand smoke" (100% vs 86.4%, p=0.01), and used e-cigarettes because they are less toxic than smoked cigarettes (96.7% vs 81.0%, p=0.01) (Table 2).

Table 3: Socio-demographics and use behaviors among currente-cigarette users who smoked at initiate of e-cigarette use (N=106),by current smoking status

		Single users only (n_1=60) %	Dual users (n_2=46) %	P value
Tobacco cigarettes smoked/day				
CurrentlyMean (S.D.)0(0.0)	7.3(7.6)	<0.01*		
At initiation of e-cigarette use	Mean (S.D.)	15.4(10.0)	21.2(8.2)	<0.01*
Reduction	Mean (95% C.I.)		13.9 (11.6~16.8)	<0.01*
Socio-demographics				
Gender	Male	88.3	97.8	0.13
	Female	11.7	2.2	
Education level	Post-graduate	13.3	2.2	0.11
	University	60.0	71.7	
	High school orless	26.7	26.1	
Region of residence	Northern Taiwan	54.2	37.8	0.11
	Central Taiwan	13.6	20.0	
	Southern Taiwan	30.5	31.1	
	Eastern Taiwan	1.7	11.1	
Monthly income	<20K	13.3	13.0	0.81
	20K-<40K	50.0	41.3	
	40K-<60K	28.3	34.8	
	>60K	8.3	10.9	
Employment status	Employed	90.0	95.7	0.46
Age	Mean (S.D.)	30.2 (7.1)	30.3 (8.0)	0.96
E-cigarette use behaviors				
Pattern of use	Daily	95.0	82.6	0.05
E-cigarette device type	Self-assembled (3rdgeneration)	93.2	77.8	0.04*
Buy e-cig device/liquid	Website	43.3/48.3	34.8/30.4	0.15
	e-cig shop	51.7/41.7	50.0/52.2	
	Others	5.0/10.0	15.2/17.4	
Nicotine containing	Yes	78.3	71.7	0.08
E-cigarette flavour	Fruit	58.3	47.8	0.42
	Chocolate	18.3	17.4	

	Others	23.3	34.8	
Length of use (months)	Mean (S.D.)	24.6 (27.0)	19.8 (15.9)	0.29
Age at first use	Mean (S.D.)	28.1 (7.6)	28.6 (7.7)	0.74
Use days/week	Mean (S.D.)	6.9 (0.5)	6.5 (1.3)	0.05
Puffs/day	Mean (S.D.)	102.9 (159.2)	136.2(140.0)	0.34
Nicotine level	Mean (S.D.)	8.3 (4.5)	10.8 (7.9)	0.08
Expense (NT$): device	Mean (S.D.)	5744 (4741)	5272 (5209)	0.64
Expense(NT$): liquid//month	Mean (S.D.)	2080 (2597)	4526 (12626)	0.22

Discussion

Under the current legislation in Taiwan, e-cigarettes containing nicotine are illegal without TFDA approval. When this study was conducted, no e-cigarette application had been submitted to the TFDA. Consequently, vaping was illegal throughout Taiwan. Nonetheless, e-cigarette use had already been reported among adults and adolescents in other surveys in Taiwan[6-8]. Even though e-cigarette use is illegal in Taiwan, there were vapers in this country who were willing to participate in an online survey, enabling us to provide a detailed characterization of a specific subset of vapers from Taiwan, a country where little accessible information about e-cigarette users exists. These Taiwanese vapers were mainly young, male, highly-educated, and employed. They had been using e-cigs for an average of almost two years and largely used nicotine-containing e-cigarettes. One of the current study's significant findings is that, amongst those who smoked cigarettes when they started using e-cigarette, most (58%) had stopped smoking by the time of the survey (to become exclusive vapers), while 42% continued to smoke (as dual users), but had substantially reduced the number of cigarettes they smoked. Also, 72.3% of participants had ever been dual users of both electronic and combustible cigarettes (i.e. had used them concomitantly). Most participants believed that e-cigarettes were effective for smoking cessation, and that they are less harmful in terms of "second-hand smoke," and less toxic than cigarettes.

Because e-cigarette are prohibited in Taiwan, users or "vapers" may be reluctant to expose themselves under the current legislation. Nevertheless, we enrolled a sample of Taiwanese vapers for investigating their characteristics. This study also had some limitations. First, the participants were from a particular subgroup of e-cigarette users who were mostly males, well educated, young but less wealthy. Second, this self-selected online sample might not be representative of all vapers in Taiwan, though in the absence of comparative data, little is known about how participants differ from vapers in the general population. As such, our results cannot be generalized beyond the subgroup of Taiwanese vapers who are able and willing to take part in an online survey. We used a self-administered on-line questionnaire, so the accuracy of reporting cannot be ascertained. The modest size of our sample (n_1=60 and n_2=46) provided only limited statistical power.

Population-based surveys in Taiwan show that the smoking rate is highest at age 51-55 for males[9], and that smoking is more frequent in people with lower education levels [9]. The only prior population-based study on vaping in Taiwan[6] found the prevalence of ever using e-cigarette was 2.7% in the whole sample, and was highest among current smokers (14.2%), among those aged 18-24 (6.5%), and among men (4.6%);among current smokers, men and women had a similar vaping prevalence. We found that the vapers in this online sample were mostly smokers at the time when they started vaping, young, higher education and mainly males, which corroborates the results of the only one prior population-based study[6] in Taiwan. The same population-based study found that current smokers were more likely than never smokers to have ever used e-cigarettes.

There is no population-based study documenting the behavioral characteristics of Taiwanese vapers. We identified much the same characteristics as reported earlier in England[2] and other countries. For instance, most vapers used e-cigarettes daily[20], used self-assembled models, refillable tanks, fruit flavors[25]; and purchased their materials and liquids in vape shops. Even though e-cigarettes are prohibited in Taiwan, we personally observed vape shops in Taiwan. Most Taiwanese vapers in this online sample consumed nicotine-containing e-cigarettes, but at lower levels than in reports from the US[26] and at higher levels than in the UK[2];they also puffed less than in previous reports[16,27].In other countries, associations with gender differ, based upon the type and flavor of e-cigarette[28]. Unfortunately, the small number of female e-cigarette users in our sample prevented us

from comparing vaping behaviors and profiles between males and females.

Other studies found that the predominant reasons for e-cigarette usewere as an aid for smoking cessation[13];because e-cigarettes were perceived as less toxic than cigarettes; as a way to get around restrictions in place in smoke-free locations[29]; and to replace tobacco cigarettes. This is congruent with our finding that e-cigarettes were perceived by the vast majority of respondents to be an effective means to stop or reduce tobacco cigarette use. It also supports previous findings suggesting that users report that e-cigarette use helps them to stop or reduce their consumption of tobacco cigarettes, and that the majority of e-cigarette users are ex-smokers[2].In Taiwan, e-cigarettes are neither systematically recommended by physicians nor endorsed by health authorities to aid smokers trying to quit smoking; nor are they allowed for use publicly in smoking areas. That may explain why these were not reported as reasons for e-cigarette use in this survey[14].

There are no specific laws pertaining to e-cigarettes in Taiwan; but existing legislation on tobacco, drugs and consumer products are applied to e-cigarettes, to regulate their manufacturing, importation, and sales[5]. However, this prohibition is probably not strictly enforced, since e-cigarette shops are found on streets, and the vapers in our survey reported purchasing e-cigarettes and e-liquids mostly containing nicotine at these e-cigarette shops. Pro-vaping groups were unsuccessful when they proposed legalizing the use, importation and production of e-cigarettes[30].To our knowledge, this is the first most detailed report on e-cigarette user behavioral characteristics in Taiwan to date. It contributes information that may be useful for the development of education campaign, and legislation reform which is currently underway with the aims of developing and establishing a comprehensive regulatory framework for e-cigarettes in Taiwan [19].

5. Conclusion

Our findings offer novel insights into the characteristic and use behaviors of a specific subgroup of vapers in Taiwan and can help generate hypotheses that can later be tested in representative samples of e-cigarette users. Many e-cigarette users in our study were daily smokers when they first started to vape, but many of them stopped smoking thereafter. Further research in representative, population-based samples should assess patterns of vaping behaviors among adults and adolescents, relationships between smoking and vaping, and investigate the attitudes and opinions of stakeholders with respect to current and future e-cigarette legislation and policies.

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