

# E-Cigarette Users' Attitudes on the Banning of Sales of Nicotine E-Liquid, Its Implication on E-Cigarette Use Behaviours and Alternative Sources of Nicotine E-Liquid

Li Ping Wong<sup>1</sup> · Haridah Alias<sup>1</sup> · Nasrin Agha Mohammadi<sup>1</sup> · Azadeh Ghadimi<sup>2</sup> · Victor Chee Wai Hoe<sup>1</sup>

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**Abstract** The banning of sales of nicotine e-liquid in e-cigarette shops has been implemented in several states in Malaysia. The distribution of nicotine e-liquid can only be allowed by licensed pharmacies or registered medical practitioners. This study aimed to evaluate e-cigarette users' responses to the control policy in a cross-sectional survey of 851 e-cigarette users by utilizing a self-report questionnaire that assessed (1) attitudes on regulation policy of e-cigarette banning; (2) e-cigarette use behaviors; and (3) sources of e-liquid after the regulation policy has been implemented. Participants from the state of Selangor where the banning policy was implemented were surveyed. The majority (95.8%) opposed the banning and believed e-cigarettes should be sold to anyone aged 18 years or above as with tobacco cigarettes, only a minority believed that nicotine e-liquid should only be available for sale over the counter in pharmacy stores (14.6%) and in clinics with a doctor's prescription (11.8%). The majority (44.2%)

reported that they would continue their e-cigarette use as before the banning policy, while 20% plan to completely stop e-cigarette usage without replacing it with any alternatives. The vast majority (87.9%) was still able to obtain nicotine e-liquid from e-cigarette shops in spite of the ban and the second most common source was from online purchase (63.1%). The sales of nicotine e-liquid from black-market were evidenced as many reported obtaining zero nicotine e-liquid from the black market (54.4%). Self- or home-made (30.8%) nicotine e-liquid was also reported. Majority of respondents that self-made e-liquid were from the average monthly income group (below MYR3000). Obtaining nicotine from the pharmacy was least preferred (21.4%). Provision of professional advice to nicotine e-liquid users along with the ban may lessen the likelihood of users switching to tobacco cigarettes or other nicotine alternatives. Banning of sales of nicotine e-liquid in e-cigarette shops resulted in a boom in the black market supplying nicotine e-liquid and, self- or home-made nicotine e-liquid. Enforcing regulations and monitoring black market sales is warranted. Efforts to educate e-cigarette users of the danger of sourcing nicotine e-liquid from the black market and self- or home-made nicotine e-liquid are essential.

✉ Li Ping Wong  
wonglp@um.edu.my; wonglp@ummc.edu.my

Haridah Alias  
fi8erbreathing@gmail.com

Nasrin Agha Mohammadi  
nasrin@um.edu.my

Azadeh Ghadimi  
azadeh.ghadimi@taylors.edu.my

Victor Chee Wai Hoe  
victorhoe@um.edu.my

<sup>1</sup> Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia

<sup>2</sup> School of Engineering, Taylors University, Lake Side Campus, 47500 Subang Jaya, Selangor, Malaysia

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## Introduction

The popularity of electronic cigarettes in Malaysia has soared since they were introduced in the mid 2000s. The thriving growth of shops selling e-cigarette products, the common sight of users of various ages in public places in Malaysia, and coupled with several reporting of e-cigarette or vaping devices explosion incidents have drawn

the authorities' attention to the regulate of the use of e-cigarettes. In 2015, it was estimated that the number of e-cigarette users in Malaysia was between 500,000 and 1 million [1]. After considerable debate, the Malaysian government has moved to regulate the boom of the e-cigarette industry by enforcing a policy on the sale of nicotine, tobacco products and e-cigarettes in early 2016. In this policy, the sale and distribution of nicotine-containing e-cigarettes liquids (e-liquid) in unregulated premises is prohibited and they are only allowed to be sold by licensed pharmacies or registered medical practitioners. The implementation of the policy has already been announced in several of the country's 13 states [2]. Nicotine is classified as a Class A poison under the Poisons Act of 1962 and the Control of Drugs and Cosmetic Regulations of 1984 (Malaysia), which forbids the sale or supply of poisons to people under 18 years old. Any breach of this policy may be liable to a fine not exceeding MYR3000 (one Malaysian Ringgit is equal to USD\$0.25) and/or up to 2 years' imprisonment [3]. Nevertheless, vaping devices without nicotine are classified as electrical appliances and are legal [4].

Needless to say, the banning of nicotine e-liquid may pose a certain level of barriers for users in obtaining their source of e-liquid. In our recent study that investigated reasons for using e-cigarettes among e-cigarette users in Malaysia, it was found that the main reason for their use was to help the user quit tobacco cigarettes [5]. Being unable to obtain nicotine e-liquid may possibly result in users switching back to tobacco cigarettes or other nicotine alternatives, which could be potentially even more harmful than e-cigarettes. Banning may also potentially cause users to obtain e-liquid from alternative sources such as the black market. Little is known about the illicit trade of e-cigarette products and e-liquid, but illicit trade in tobacco cigarettes in Malaysia is not uncommon. Due to the high price of tobacco cigarettes, obtaining them from the black market has been reported in the news media in Malaysia [6]. Likewise, banning of nicotine e-liquid may potentially boost the illegal trade of e-cigarettes. Users may be exposed to hazards posed by the uncertain content or levels of toxicants present in e-liquid on the black market [7].

As the banning of sales of nicotine e-liquids has been implemented in our country, it is vitally important to survey the Malaysian e-cigarette users' attitudes towards this ban and its impact on their smoking behaviors and the sources to obtain their nicotine e-liquid supply. The objectives of this study were to assess (1) the attitudes of e-cigarette users towards the regulation policy of the nicotine e-liquid ban; (2) e-cigarette use behaviors; and (3) the sources of nicotine e-liquid after the regulation policy has been implemented.

## Materials and Methods

### Study Participants and Settings

A cross-sectional study using a convenience sample of e-cigarette users were conducted between March and June 2016 at electronic cigarette retail businesses in Selangor and Kuala Lumpur. Permission from the electronic cigarette retail shop owners was obtained to administer the survey to their customers who were e-cigarette users. Informed consent was obtained from the study participants and they were assured of the confidentiality of their information. Snowball sampling was also used, in which study participants nominated other potential respondents to complete the sample. The study was approved by the University Malaya Medical Ethics Committee (MECID No: 20148-456). Informed consent for the interview was obtained from the respondents.

### Study Questionnaire

The first section assessed the participants' socio-demographic background. The second section included four items that assessed participants' practices regarding the use of electronic cigarettes: e-cigarette smoking status (single or dual use (use of both tobacco and e-cigarettes)); duration of smoking e-cigarettes; amount of e-liquid used in a day; and the concentration of the nicotine liquid used. The third section assessed attitudes toward the regulation policy of e-cigarettes and the fourth section questioned participants' e-cigarette use behaviors after the implementation of the ban. The final section assessed sources of obtaining nicotine e-liquid (multiple-response items in which respondents can choose more than one answer).

### Data Analyses

All the data were entered and analyzed using SPSS version 19.0 for Windows (SPSS Inc., Chicago, IL). Descriptive statistics, a Chi square test and multivariate logistic regression were used to analyze the data. Significant associations ( $p < 0.05$ ) in univariate analyzes were entered into the multivariate logistic regression model. The multivariate logistic regression models were used to determine factors associated with obtaining e-liquid from the black market and home-made e-liquid. Adjusted odds ratio (OR) and 95% confidence interval (95% CI) were calculated.

## Results

A total of 851 participants responded to the survey. The first and second columns of Table 1 present the

**Table 1** Distribution of socio-demographic characteristics and sources of nicotine e-liquid (N = 851)

	N (%)	Source of nicotine e-liquid			Logistic regression	Source of nicotine e-liquid			Logistic regression
		Black market (N = 463)	Others (N = 388)	P value		Home-made (N = 262)	Others (N = 589)	P value	
<i>(A) Socio-demographic data</i>									
<i>Age group</i>									
18–28 years old	339 (39.8)	197 (58.1)	142 (41.9)			116 (34.2)	223 (65.8)		
29–39 years old	380 (44.7)	201 (52.9)	179 (47.1)	0.162		112 (29.5)	268 (70.5)	0.154	
≥40 years old	132 (15.5)	65 (49.2)	67 (50.8)			34 (25.8)	98 (74.2)		
<i>Gender</i>									
Male	809 (95.1)	443 (54.8)	366 (45.2)	0.428		257 (31.8)	552 (68.2)	0.006	2.964 (0.867–10.131)
Female	42 (4.9)	20 (47.6)	22 (52.4)			5 (11.9)	37 (88.1)		Reference
<i>Marital status</i>									
Single	401 (47.1)	212 (52.9)	189 (47.1)	0.409		137 (34.2)	264 (65.8)	0.045	1.118 (0.770–1.625)
Ever married	450 (52.9)	251 (55.8)	199 (44.2)			125 (27.8)	325 (72.2)		Reference
<i>Ethnic</i>									
Malay	642 (75.4)	351 (54.7)	291 (45.3)			193 (30.1)	449 (69.9)		
Chinese	178 (20.9)	94 (52.8)	84 (47.2)	0.832		62 (34.8)	116 (65.2)	0.286	
Indian	31 (3.6)	18 (58.1)	13 (41.9)			7 (22.6)	24 (77.4)		
<i>Education</i>									
Secondary and below	292 (34.3)	164 (56.2)	128 (43.8)			79 (27.1)	213 (72.9)		
Higher than secondary	559 (65.7)	299 (53.5)	260 (46.5)	0.469		183 (32.7)	376 (67.3)	0.100	
<i>Occupation</i>									
Professional & managerial	308 (36.2)	153 (49.7)	155 (50.3)			81 (26.3)	227 (73.7)		
Manual worker	410 (48.2)	238 (58.0)	172 (42.0)	0.104		134 (32.7)	276 (67.3)	0.139	
Student	132 (15.5)	72 (54.5)	60 (45.5)			47 (35.6)	85 (64.4)		
Retiree	1 (0.1)	–	1 (100.0)			–	1 (100.0)		
<i>Monthly income (N = 624)</i>									
≤RM3000	230 (36.9)	136 (59.1)	94 (40.9)			89 (38.7)	141 (61.3)		1.244 (0.718–2.156)
RM3000–6000	304 (48.7)	180 (59.2)	124 (40.8)	0.905		75 (24.7)	229 (75.3)	0.002	0.685 (0.408–1.152)
>RM6000	90 (14.4)	51 (56.7)	39 (43.3)			29 (32.2)	61 (67.8)		Reference
<i>(B) E-cigarettes use behaviour</i>									
<i>Smoking status</i>									
E-cig only	385 (45.2)	194 (50.4)	191 (49.6)	0.038	Reference	120 (31.2)	265 (68.8)	0.881	
Dual user (e-cig and tobacco)	466 (54.8)	269 (57.7)	197 (42.3)		1.382 (1.044–1.828)*	142 (30.5)	324 (69.5)		
<i>Duration of smoking</i>									
≤1 year	473 (55.6)	244 (51.6)	229 (48.4)			132 (27.9)	341 (72.1)		
>1–2 years	227 (26.7)	132 (58.1)	95 (41.9)	0.180		78 (34.4)	149 (65.6)	0.126	
>2 years	151 (17.7)	87 (57.6)	64 (42.4)			52 (34.4)	99 (65.6)		
<i>Measurement of e-liquid vaped in a day</i>									
≤5 ml	228 (26.8)	143 (62.7)	85 (37.3)		1.672 (1.093–2.560)*	73 (32.0)	155 (68.0)	0.479	
>5–10 ml	473 (55.6)	248 (52.4)	225 (47.6)	0.008	1.200 (0.824–1.749)	149 (31.5)	324 (68.5)		

**Table 1** (continued)

	N (%)	Source of nicotine e-liquid			Logistic regression	Source of nicotine e-liquid			Logistic regression
		Black market (N=463)	Others (N=388)	P value		Home-made (N=262)	Others (N=589)	P value	
>10 ml	150 (17.6)	72 (48.0)	78 (52.0)		Reference	40 (26.7)	110 (73.3)		
Nicotine liquid concentration frequently used									
0 mg/30 ml	40 (4.7)	31 (77.5)	9 (22.5)		2.832 (1.265–6.342)*	12 (30.0)	28 (70.0)		
6 mg/30 ml	408 (47.9)	204 (50.0)	204 (50.0)	0.006	0.776 (0.539–1.117)	116 (28.4)	292 (71.6)	0.165	
9 mg/30 ml	222 (26.1)	126 (56.8)	96 (43.2)		1.031 (0.687–1.548)	66 (29.7)	156 (70.3)		
≥12 mg/30 ml	181 (21.3)	102 (56.4)	79 (43.6)		Reference	68 (37.6)	113 (62.4)		

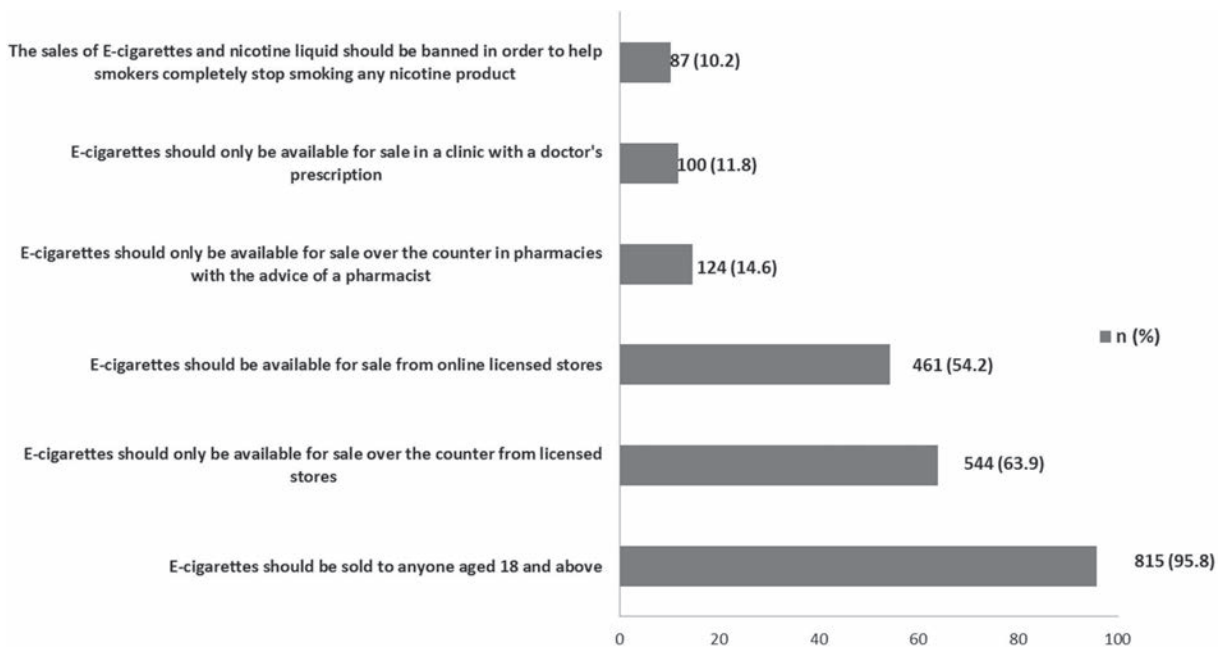
#Hosmer and Lemeshow test; chi square = 1.961, sig = 0.923, Nagelkerke R<sup>2</sup> = 0.041

\*Hosmer and Lemeshow test; chi square = 0.989 sig = 0.911, Nagelkerke R<sup>2</sup> = 0.036

socio-demographic characteristics of the study participants. Most of the respondents were below the age of 40 years old (n = 719, 84.5%). The majority were Malay (n = 642, 75.4%). Most of them had a secondary education (n = 559, 65.7%). For the distribution of respondents by type of occupation, most of the respondents were manual workers (n = 410, 48.2%), followed by professional and managerial workers (n = 308, 36.2%). The majority of respondents reported having an average monthly income of RM3000

and below (n = 230, 36.9%). Of the total study sample, slightly over half were dual users (use of both tobacco and e-cigarettes) (n = 466, 54.8%), had been using e-cigarettes for not more than a year (n = 473, 55.6%), and only 4.7% (n = 40) commonly used zero nicotine e-liquid.

Figure 1 shows the findings on attitudes towards the regulation policy of sales of nicotine e-liquid, charting the proportion of responses that agree with the statement questioned. The vast majority of respondents viewed that



**Fig. 1** Attitudes towards regulation policy of sales of nicotine e-liquid sales (N = 851)

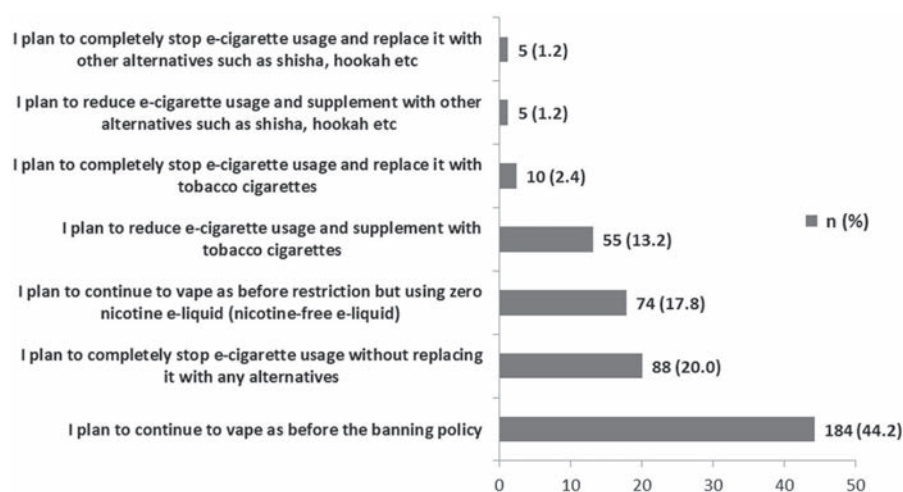
nicotine e-liquid should be sold to anyone aged 18 years and above. Nearly two-thirds were of the opinion that nicotine e-liquid should be sold in licensed stores. Nearly half felt that nicotine e-liquid should be sold in licensed online stores. A minority thought that nicotine e-liquid should only be available for sale over the counter in pharmacy stores (14.6%) and in clinics with a doctor’s prescription (11.8%). Only approximately 10% of all respondents supported the banning of nicotine e-liquid sales.

Figure 2 shows participants’ e-cigarette use behavior after the banning of the sales of nicotine e-liquid in e-cigarette shops. Of the total 421 participants who responded to the question, the majority of them (44.2%) reported that they would continue their e-cigarette use as before the banning policy. A total of 20% (n=88) reported they planned to completely stop e-cigarette usage without replacing it with any alternatives. A total of 17.8% (n=74) planned to continue to use e-cigarettes and use zero nicotine e-liquid. A total of 18% expressed the intention to reduce or stop

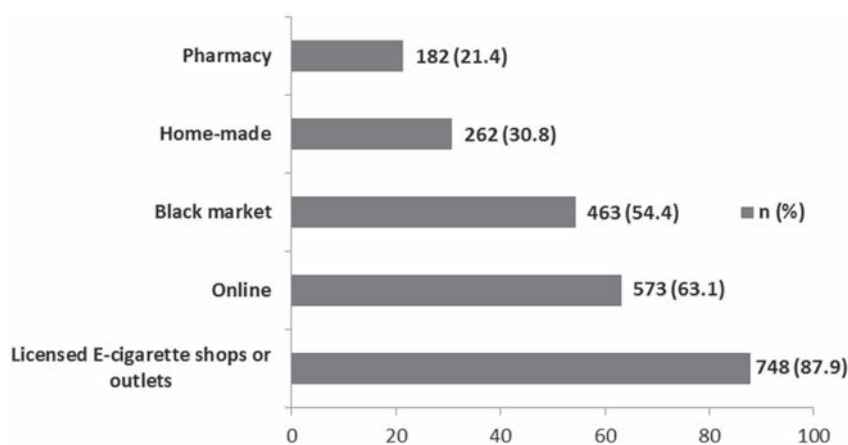
using nicotine e-liquid and replace it with tobacco cigarettes or other alternatives.

Figure 3 shows the proportion of participants reporting the means of obtaining nicotine e-liquid after the banning implementation. The vast majority (87.9%) reported obtaining nicotine e-liquid from e-cigarette shops. The second most popular means of obtaining e-liquid was from online stores (63.1%). Slightly over half reported obtaining e-liquid from the black market (54.4%), and only 21.4% from a pharmacy. Subsequently, the characteristics of respondents who obtained e-liquids from the black market and home-made e-liquids were further analyzed. Table 1 shows no demographic differences between respondents who obtained e-liquid from the black market compared to other sources. Respondents who obtained e-liquid from the black market were likely to be dual users than using e-cigarettes only (OR 1.382, 95% CI 1.044–1.828). Higher proportions of respondents who obtained e-liquid from the black market were users that used less than 5 ml of e-liquid

**Fig. 2** E-cigarette use behaviors after nicotine e-liquid ban policy (N=421)



**Fig. 3** Sources of getting nicotine e-liquid (N=851)



a day compared to those who used over 10 ml/day (OR 1.672, 95% CI 1.265–6.342). The majority of respondents who reported obtaining e-liquid from the black market are likely to be users of zero nicotine e-liquid concentration compared to users of 12/30 ml nicotine concentration (OR 2.832, 95% CI 1.265–6.342). The number of respondents who reported making their own nicotine e-liquid was significantly higher among male and single participants. The majority of respondents that made e-liquid were had monthly income of below RM3000. Multivariate analysis found no significant factors associated with the likelihood of home-made e-liquid compared to other sources of e-liquid investigated in the study.

## Discussion

As anticipated, the banning of sales of nicotine e-liquid was not supported by the majority of the study participants. Many of them were of the opinion that nicotine e-liquid should be sold just like any other tobacco products, which is to anyone aged 18 years and above. Only a minority agreed that sales of nicotine e-liquid should be banned in order to help smokers completely stop using any nicotine product. About two-thirds of the study participants thought that instead of completely banning nicotine e-liquid, it should only be allowed to be sold by licensed stores. This may imply that some of the e-cigarette users agreed to the regulation of the sales and they were aware of the danger of obtaining nicotine e-liquids from non-licensed sources. Other e-cigarette users have to be made aware that the regulation of sales of e-cigarettes at licensed stores is to ensure product safety and consistency and prevent consumers from obtaining e-cigarette devices or e-liquids that do not meet safety or labeling standards.

The majority of participants expressed disagreement with the statement that nicotine e-liquid should only be available for sale in pharmacies or in clinics with a prescription from a doctor. Pharmacists or doctors may only prescribe e-cigarettes as a quit-smoking aid, and therefore many participants were reluctant to obtain them from pharmacists or doctors if the use of e-cigarettes is for recreational and long-term purposes, and not as a quit-smoking aid. Findings imply the necessity to educate e-cigarette users to understand the underlying benefits of obtaining e-cigarettes from pharmacists and medical practitioners. Firstly, e-cigarette users should be made aware of the benefit of obtaining e-liquid from health experts, as consulting health experts in the event of the banning of nicotine e-liquid may additionally provide a chance for users to quit nicotine addictions. Further, the sale of nicotine e-liquid by pharmacists and medical practitioners certainly may also effectively control sales

of e-cigarettes to underage users. The news media have reported that in Malaysia there are an estimated 1 million vapers, of which 10% are underage [8]. On the same note, the sales of cigarettes, which contain the nicotine that has been classified as a Class A poison under the Poisons Act of 1962, i.e., highly toxic and can be lethal even in very small dosages, should also be further regulated similar to the sales of e-liquids.

The banning of sales of nicotine e-liquid received mixed responses regarding e-cigarette use behaviors. Although many reported that they may continue using e-cigarettes as before the ban, on the positive side, a considerable proportion of the participants reported that they planned to completely stop e-cigarette usage without replacing it with any alternatives. Banning sales of e-liquid may be taken positively by some e-cigarette users as a cue to action for them to stop vaping. The banning undoubtedly has a positive impact on some e-cigarette users to attempt quitting. Another positive impact is the switch to zero nicotine e-liquid. Apparently, a considerable number reported the intention to switch to zero nicotine e-liquid. In contrast, one negative effect of the nicotine e-liquid ban is the expression of the intention to switch to conventional tobacco cigarettes or other alternatives, such as the shisha or hookah. Findings suggest the necessity of providing education or guideline for e-cigarette users along with the banning of sales of nicotine e-liquid. They should be led to encourage more positive or healthy behaviors upon the banning of the sales of nicotine e-cigarettes. It is imperative that users of nicotine e-liquid are encouraged or guided to seek professional help with giving up their use of nicotine e-liquid, this further support the sales of e-liquids only as a by prescription as quit-smoking aid. They should be informed that there is solid evidence that quit-smoking services by health experts help users to completely stop smoking. This may avoid users from switching to other nicotine alternatives, which may pose an even more harmful impact to health than e-cigarettes.

In states where banning was imposed in Malaysia, users can still access the sales of nicotine e-liquid from pharmacists and medical practitioners where sales must be recorded. In this study, none of the participants reported obtaining e-liquid nicotine from physicians and only a small proportion said that they obtained e-liquid from pharmacies. One reason for being reluctant to obtain e-liquid from physicians could be due to the consultation fees if they were to see a physician. Secondly, as pharmacists or doctors may only prescribe e-cigarettes as a quit-smoking aid, participants may foresee the unlikelihood of being able to continuously obtain an e-liquid supply from both the pharmacists and doctors. Users should be advised to take advantage of the banning policy to quit e-cigarette use and to reduce nicotine addiction.

A large proportion reported continuously obtaining nicotine e-liquid from licensed e-cigarette shops despite the implementation of the regulation that only zero nicotine e-liquid can be sold in licensed shops. These findings may imply that nicotine e-liquid is still being sold illegally by the existing e-cigarette retailers. This again provides evidence that retail shops may also secretly sell nicotine e-liquid amidst the legally allowed zero-nicotine. Further investigation is needed to confirm the participants' reports of the potential violation by e-cigarette shops in selling e-liquid with nicotine content. Authorities should look into tightening the regulations of selling nicotine e-liquid amidst zero nicotine e-liquid in shops. Failing to do so could lead to the efforts to accomplish the goal of the banning of nicotine e-liquid being unsuccessful.

A considerable high proportion of respondents reported obtaining nicotine e-liquid online, which also implies for the need for the banning policy to also control sales of nicotine e-liquid online. It is suggested that online e-cigarette sales should be regulated or controlled much like virtual e-cigarette shops. Online sales of e-cigarettes have long existed in Malaysia. Online stores, be they licensed or unlicensed, have grown along with the boom in virtual e-cigarette stores. With the banning of sales of nicotine e-liquid in virtual outlet stores, many e-cigarette users turned to online shopping to obtain e-cigarettes. As the sales of e-cigarettes online were not regulated, over half of our study participants were in agreement that e-cigarettes should be obtained via online licensed stores. Many can thus easily access nicotine e-liquid. Although Internet vendors verify the age of purchasers, nevertheless, underage customers can easily obtain e-cigarettes or nicotine e-liquid using fake identification. The ease with which the underage can obtain nicotine e-liquid online has been reported [9]. Thus, strict enforcement of regulation of online sales of e-cigarette products, including nicotine e-liquid and in particular to young people, is warranted.

An important finding of this study is undoubtedly the evidence of the emergence of the black-market trade in nicotine liquids. Slightly over half of participants reported obtaining nicotine e-liquid from the black market, implying the potential risk incurred from the black-market supply chain, such as the uncertainty of the safety and quality of the product. There is a need for the relevant authority to monitor the black-market supply chain and the safety of e-liquid sold on the black market [7]. E-liquid from the black-market may be of dubious origin and quality, which will cause more harm than those currently available [7, 10]. Of note, although zero nicotine e-liquid is not banned, in this study many who obtained nicotine e-liquid were also users of zero nicotine e-liquid. This implies the popularity of the black-market as a source of e-liquids. Many e-cigarette users obtained zero nicotine e-liquid from the

black-market despite it being legally sold in e-cigarette shops. It could be that the black market offers a relatively lower price than e-cigarette shops, but further study is needed to find out the price differences.

Another noteworthy finding of our study is the fact that nearly one-third of participants reported having used home-made nicotine e-liquid. The fact that many of those who use home-made nicotine e-liquid were of the lower income group indicated that targeted and tailored intervention in future should be directed towards them to educate them of the dangers of home-made e-liquids. They should be informed that home-made e-liquids can be potentially dangerous and should not be attempted without proper knowledge and experience. An erroneous mix of harmful levels of liquid nicotine may potentially result in nicotine poisoning [11].

This study has several limitations. Due to the difficulty in getting a complete sampling frame of e-cigarette users in Malaysia and the sensitivity of using e-cigarettes since the e-cigarette banning policy has been implemented, convenience and purposive sampling of e-cigarette users were recruited. Thus, the major limitation of this study is the reliance on the sampling methods, which may pose a bias sample, and on self-reports. Therefore, the results cannot be generalized to the entire population of e-cigarette users in Malaysia. While the current findings should be interpreted with caution due to the study limitations, they are nonetheless very encouraging as they represent the first evaluation of e-cigarette users' perspective on the banning of sales of nicotine e-liquid and how the ban impacts on their e-cigarette use behaviors and sources of nicotine e-liquid.

## Conclusions

The banning of sales of nicotine e-liquid was not supported by the majority of e-cigarette users. Although the majority expressed the intention to continue using e-cigarettes, on the positive side, a considerable number of users planned to discontinue using nicotine e-cigarettes without replacing them with any alternatives. Nonetheless a minority expressed the intention to reduce or stop nicotine e-liquid and replace it tobacco cigarettes or other alternatives. The study found evidence relating to the black-market sales of e-liquid. The lower social-economic group users also tended to report the use of home-made nicotine e-liquid. The sourcing of nicotine e-liquid from physicians and pharmacists was not favored. The findings imply the need for the provision of professional advice to nicotine e-liquid users along with the ban in order to lessen the likelihood of users switching to tobacco cigarettes or other nicotine alternatives. Authorities should look into tightening regulations to restrict black-market sales of nicotine e-liquid. Regulatory

tightening of home-made nicotine e-liquid should also be implemented. Efforts to educate e-cigarette users of the dangers of sourcing nicotine e-liquid from the black market and home-made nicotine e-liquid are essential.

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#### Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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