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Original Article

Sociodemographic differences in awareness of e-cigarette in Malaysia

Yong Kang Cheah [a, b, *], Chien Huey Teh [c], Hock Kuang Lim [b]

[a] School of Economics, Finance and Banking, College of Business, Universiti Utara Malaysia, 06010 UUM Sintok, Kedah Darul Aman, Malaysia
[b] The Center for Health and the Social Sciences (CHeSS), University of Chicago, 5841 S. Maryland Ave, Chicago, IL, 60637, USA
[c] Institute for Medical Research, Jalan Pahang, 50588, Kuala Lumpur, Malaysia

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ABSTRACT

Aim: Electronic cigarette (e-cigarette) plays an important role in preventing smoking-induced diseases. However, the majority of people are not aware of e-cigarette. The present study attempts to characterise awareness of e-cigarette in the overall Malaysian population and to explore its associated factors.
Materials and methods: The data is obtained from the Global Adult Tobacco Survey (GATS). The survey consists of a large sample size (n = 4176). In order to examine sociodemographic differences in the likelihood of being aware of e-cigarette, multivariable logistic regressions stratified by ethnic groups are used.
Results: Age, gender, education, ethnicity and cigarette smoking are independently associated with awareness of e-cigarette. Older individuals display a lower likelihood of being aware of e-cigarette than younger individuals (aOR: 0.977). Males are more likely to be aware of e-cigarette than females (aOR: 2.537). A lower likelihood of being aware of e-cigarette is reported by individuals with primary-level (aOR: 0.173) and secondary-level education (aOR: 0.389). Awareness of e-cigarette is higher among smokers (aOR: 1.438).
Conclusion: Considering the sociodemographic variations in awareness of e-cigarette, policy makers should develop an intervention measure in efforts to provide people with more information on e-cigarette with a focus on those who likely to be unaware of e-cigarette.

1. Introduction

Smoking leads to various serious diseases, such as cardiovascular disease, lung cancer and chronic obstructive pulmonary disease. There are approximately one billion smokers in the world, and each year, about seven million mortalities are related to smoking.[1] The majority of smokers (80%) are in developing countries.[1] For many years, the main strategy directed towards reducing the diseases induced by smoking focused on promoting smoking cessation. While this strategy is effective in reducing the prevalence of smoking,[2,3] its results may not be long-term. As pointed out by researchers, the number of ex-smokers who relapse is high as nearly 80% of smokers who have quitted return to smoking within one month.[4,5]

Smokers are addicted to nicotine and have the habit of smoking triggered by various environmental cues.[6] They enjoy the rituals associated with smoking. People who have stopped smoking may crave for nicotine and consequently return to smoking.[7] Although nicotine replacement therapies, such as patches, gums and inhalers can reduce the withdrawal symptoms and the sensations of craving during smoking cessation, they do not replace the sensory cues and rituals associated with smoking.[8] Hence, they may not be very effective in reducing smoking prevalence in the long-run.

It is clearly evident that the harmful effects of smoking on health are mainly related to the toxic substances generated during tobacco combustion, instead of nicotine.[9] Thereby, Tobacco Harm Reduction should include the use of non-combustible, less toxic and nicotine-containing product as a substitution for ordinary cigarette. This product must be able to provide smokers with nicotine in a manner as similar as cigarettes and allow smokers to indulge in ritualistic behaviour of smoking, but at the same time lowering the adverse effects on health. Electronic cigarette (e-cigarette) appears to be a suitable candidate for this product. e-cigarette is an electronic

* Corresponding author. School of Economics, Finance and Banking, College of Business, Universiti Utara Malaysia, 06010 UUM Sintok, Kedah Darul Aman, Malaysia.
E-mail addresses: cheahykang@gmail.com (Y.K. Cheah), chienhuey@imr.gov.my (C.H. Teh), keelimkota@yahoo.com (H.K. Lim).
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device that delivers vaporised nicotine to the users. The examples of e-cigarette include cigalikes, eGos and mods. The liquid used in e-cigarette contains nicotine, glycerol, flavourings and other chemicals. Because e-cigarette does not contain tobacco and use combustion, e-cigarette users are claimed to be safer than ordinary cigarette users. Farsalinos and Polosa conducted a systematic review of studies related to risk of e-cigarette and found that e-cigarette is a healthier alternative to ordinary cigarette.[10] Hartmann-Boyce et al. identified that e-cigarette is safer than ordinary cigarette and can help smokers to quit smoking.[7] Adriaens et al. found that e-cigarette smokers display a high smoking quit-rate.[11] The effectiveness of e-cigarette were also evidenced by others.[12,13] While e-cigarette is better than ordinary cigarette in general, the users must be cautious about its side effects as it may cause lung diseases and breathing problems.

Even though it cannot be denied that quitting smoking remains the best method to prevent smoking-induced diseases, policies aimed at promoting the use of e-cigarette among smokers should be given considerations as well. In spite of the importance of e-cigarette, only a few studies have been conducted to understand factors associated awareness of e-cigarette, especially in developing countries, where smoking is highly prevalent. Policy makers must ensure that people are aware of e-cigarette. They should learn about which groups of population know or do not know e-cigarette if the objective of promoting the use of e-cigarette as a method to reduce smoking-induced diseases and mortalities is to be met. In Malaysia, that is, a fast-growing developing country, Goh et al. are among a few researchers who examine the determinants of e-cigarette awareness.[14] Their analysis is based on a small sample of university students ($n = 404$). They have found that males are less likely to use e-cigarette than females, and having a well-educated parent is associated with a reduced likelihood of using e-cigarette. However, the relationships between sociodemographic factors and e-cigarette awareness are not well-identified in their study because their sample lacks variation. This is due to a very small number of respondents ($n = 20$) reporting 'not aware of e-cigarette'. The present study attempts to fill this research gap and contribute to the existing literature and policy development by investigating the sociodemographic factors associated with awareness of e-cigarette in great detail. The present study differs from study of Goh et al. in several ways.[14] Firstly, a nationally representative data that contains a large sample size ($n = 4176$) is used. Secondly, all age groups of population are taken into account for in-depth examinations. Thirdly, analyses of the present study are stratified by ethnic groups. In particular, the ethnic groups in Malaysia consist of Malay, Chinese, Indian and Others. Malay is the ethnic majority, followed by Chinese, Indian and Others. Findings of any differences or similarities in factors associated with awareness of e-cigarette amongst the ethnic groups are important contributions.

2. Material and Methods

2.1. Participants and procedure

The present study uses the secondary analysis of Global Adult Tobacco Survey (GATS) Malaysia, which is the most recent tobacco related nationwide survey conducted by the Ministry of Health Malaysia and World Health Organization.[15] The survey was conducted from October to December 2011. Respondents were selected based on a multistage stratified sampling. In the first stage, 426 enumeration blocks (EBs) (222 in urban areas and 204 in rural areas) were selected from the total 74756 EBs (48574 in urban areas and 26182 in rural areas). The selection criteria were based on the total population size. In the second stage, twelve living quarters (LQs) were chosen from each selected EB. Approximately 80–120 LQs were in each EB. In the third stage, members in the sampled households were randomly selected. Inclusion criteria were those aged 15 years and above, and were not institutionalised in hospitals, hostels, nursing homes, military bases or prisons. The self-administrative questionnaires were prepared in two languages (English and Malay), and during face-to-face interview, four languages were used (English, Malay, Mandarin and Tamil). Overall, 4389 individuals were surveyed. Interviewers were requested to obtain written consents from the selected respondents. For respondents aged 16 years and below, written consents from their parents or guardians were necessary. Data for 213 respondents were deleted due to missing information. Hence, only 4176 respondents or 95.15% of the total sample were included for analyses.

The average age of respondents was approximately 41 years (see Table 1). The age range was from 15 to 93 years. The majority of respondents were female (50.60%). A large proportion of respondents had secondary-level education (57.85%), followed by those with primary-level (32.50%) and tertiary-level education (9.65%). More than half of respondents were employed (55.24%). The ethnic breakdown comprised 59.77% Malay, 14.82% Chinese, 6.25% Indian and 19.16% Others. This ethnic structure was quite similar to that of Malaysian population which comprises 51% Malay, 24.2% Chinese, 7.2% Indian and 17.6% Others. The majority were married (63.84%), while only a very small proportion were widowed/divorced (11.61%). Less than one-third of respondents were smokers (23.35%), and only less than one-tenth had the intention to quit smoking (9.63%).

2.2. Assessments

Awareness of e-cigarette. Awareness of e-cigarette was assessed by asking respondents 'Have you ever heard of e-cigarettes?'. Those who answered 'yes' were considered to be aware of e-cigarettes, whereas those who answered 'no' were considered to be unaware of e-cigarettes.

Sociodemographic information. Survey included questions about age, gender, education, employment status, ethnicity and marital status. Respondents reported their age (in years) and gender [male vs female (baseline category)]. Respondents also reported their highest academic qualification. Their answers were categorised into three categories: primary (<7 schooling years), secondary (7–11 schooling years) and tertiary (>11 schooling years) (baseline category). Employment status was assessed by asking respondents 'Which of the following best describe your current main employment status?' The possible answers were 'government servant', 'non-government servant', 'self-employed', 'student', 'homemaker', 'retiree' and 'not work'. Based on these answers, two categories were formed: employed (government servant, non-government servant, self-employed) and unemployed (student, homemaker, retiree, not work) (baseline category). Respondents were requested to report their ethnic background. They answered with 'Malay' (baseline category), 'Chinese', 'Indian' or 'other ethnic backgrounds (Others)'. In addition, marital status was reported: married, widowed/divorced and single (baseline category).

Smoking behaviour. In addition to sociodemographic profiles, details of cigarette smoking and intention to quit smoking were obtained. Respondents indicated whether they currently smoke cigarette [smoker vs non-smoker (baseline category)]. Only respondents who smoked cigarette answered the following question 'In the last 12 months, have you ever tried to quit smoking?' Those answering 'yes' were considered to have the intention to quit smoking, whilst those answering 'no' were considered to have no intention (baseline category).

Table 1
Characteristics of respondents and test of differences in e-cigarette awareness.

Variables	Total (n = 4176)		Awareness[b] (n = 706)		Test of differences
	N/M[a]	%/SD[a]	N/M[a]	%/SD[a]	
Age	41.33	16.35	–	–	–
Gender					
Male	2063	49.40	514	24.92	186.169*
Female	2113	50.60	192	9.09	
Education					
Primary	1357	32.50	77	5.67	270.517*
Secondary	2416	57.85	473	19.58	
Tertiary	403	9.65	156	38.71	
Employment					
Employed	2307	55.24	514	22.28	105.965*
Unemployed	1869	44.76	192	10.27	
Ethnicity					
Malay	2496	59.77	492	19.71	54.306*
Chinese	619	14.82	102	16.48	
Indian	261	6.25	44	16.86	
Others	800	19.16	68	8.50	
Marital status					
Married	2666	63.84	432	16.20	88.423*
Widow/divorce	485	11.61	25	5.15	
Single	1025	24.55	249	24.29	
Smoking					
Smoker	975	23.35	267	27.38	99.418*
Non-smoker	3201	76.65	439	13.71	
Quit smoking					
Intended	402	9.63	124	30.85	61.528*
Unintended	3774	90.37	582	15.42	

Note: *$p < 0.05$.
[a] For age, the values refer to mean (M) and standard deviation (SD). For other variables, the values refer to frequency (N) and percentage (%).
[b] Respondents who are aware of e-cigarettes.
Source: GATS 2011

2.3. Data analysis

Mean, standard deviation, frequency and proportion for the entire sample were calculated. Relationships between sociodemographic factors and awareness of e-cigarette were analysed using Pearson's Chi-squared test. Because the data has a large sample size, Pearson's Chi-squared is used, instead of Fisher exact. In addition, a multivariable logistic regression was utilised to explore the independent effects of sociodemographic factors (age, gender, education, employment status, ethnicity, marital status, cigarette smoking, intention to quit smoking) on the likelihood of being aware of e-cigarette. Furthermore, regressions were stratified by ethnic groups. It was expected that sociodemographic variations in awareness of e-cigarette may vary across ethnic groups because of cultural and religious differences. To test the overall significance of the regression models, likelihood ratio (LR), Pearson's Chi-squared and Hosmer-Lemeshow tests were conducted. Moreover, variance inflation factors (VIFs) of all the independent variables were calculated in order to detect potential multicollinearity problem. Significant levels of all the tests were $p < 0.05$. Statistical analyses were performed using Stata statistical software.[16]

3. Results

Awareness of e-cigarette is significantly associated with various sociodemographic factors (see Table 1). Approximately 24.92% of males are aware of e-cigarette, compared with only 9.09% of females. The proportion of tertiary-educated individuals being aware of e-cigarette (38.71%) are higher than those of individuals with only secondary-level (19.58%) and primary-level education (5.67%). In terms of employment status, about 22.28% of employed individuals compared with 10.27% of unemployed individuals have heard of e-cigarette. A significant higher proportion of Malays (19.71%) compared with Chinese (16.48%), Indian (19.86%) and Others (8.50%) are aware of e-cigarette. Nearly a quarter of single individuals have heard of e-cigarette (24.29%), compared with only 16.20% and 5.15% of married and widowed/divorced individuals, respectively. A higher proportion of smokers (27.38%) are aware of e-cigarette compared with non-smokers (13.71%). More than one-fourth of those who are intended to quit smoking have heard of e-cigarette (30.85%), compared with 15.42% of those who are unintended.

Results of multivariable logistic regression derived from the overall sample show that age, gender, education, ethnicity and cigarette smoking have independent effects on the likelihood of being aware of e-cigarette (see Table 2). The LR statistics is highly significant, indicating that all the independent variables are jointly significant in explaining the dependent variable. Additionally, a large proportion of the outcomes are correctly predicted by the model (83.40%) and the *p*-values of Pearson's Chi-squared, and Hosmer-Lemeshow are high. Taken together, it can be concluded that the model is well-specified. Multicollinearity is also not an issue because the maximum value of VIF is only 3.790. It is not surprising that the constant is significant because there could be non-sociodemographic factors that affect awareness of e-cigarettes, such as presence of chronic diseases and hereditary illnesses, which are unable to be included in the present study.

An additional year of age reduces the odds of being aware of e-cigarettes [adjusted odds ratio (aOR): 0.977]. Males are more likely to hear about e-cigarettes than females (aOR: 2.537). Compared with individuals with tertiary-level education, individuals with primary-level (aOR: 0.173) and secondary-level education (aOR: 0.389) have lower odds of being aware of e-cigarettes. Individuals from other ethnic backgrounds report a lower likelihood of being aware of e-cigarettes than Malays (aOR: 0.365). Holding sociodemographic factors constant, smokers are more likely to be aware of e-cigarettes than non-smokers (aOR: 1.438).

The odds of being aware of e-cigarettes among different ethnic groups suggest likewise that age, gender, education, ethnicity and cigarette smoking are significant independent variables (see Table 2). The LR statistics of all the models are highly significant, and this implies that all the independent variables are jointly significant in affecting the dependent variable in the regressions that are stratified by ethnic groups. The models also fit decently given that the proportion of outcomes that are correctly predicted are high (81–91.5%), the values of Pearson's Chi-squared and Hosmer-Lemeshow are insignificant, and maximum values of VIF are low.

Age is associated with decreased odds of being aware of e-cigarette among Malays (aOR: 0.973). Males from Malay (aOR: 2.694), Indian (aOR: 3.633) and Others ethnic groups (aOR: 3.332) are more likely to hear about e-cigarette than their female counterparts. Of all the ethnic groups, individuals with primary-level (aOR: 0.101–0.217) and secondary-level education (aOR: 0.252–0.575) display a lower likelihood of hearing about e-cigarette than those with tertiary-level education. Malays (aOR: 1.409) and Chinese (aOR: 4.562) smokers are more likely to hear of e-cigarette than their peers who do not smoke.

4. Discussion

e-cigarette plays an important role in preventing smoking-induced diseases. The objective of the present study is to examine the factors associated with awareness of e-cigarette in a sample of Malaysian population. There appear to be significant relationships between awareness of e-cigarette and

Table 2
Sociodemographic factors associated with the odds of being aware of e-cigarettes: total sample, Malay, Chinese, Indian and Others.

Variables	Total	Malay	Chinese	Indian	Others
	(n = 4176)	(n = 2496)	(n = 619)	(n = 261)	(n = 800)
Constant	0.688*	0.674	0.878	0.414	0.273*
Age	0.977*	0.973*	0.980	0.989	0.987
Gender					
Male	2.537*	2.694*	1.389	3.633*	3.332*
Female	1.000	1.000	1.000	1.000	1.000
Education					
Primary	0.173*	0.184*	0.101*	0.202*	0.217*
Secondary	0.389*	0.390*	0.252*	0.354*	0.575
Tertiary	1.000	1.000	1.000	1.000	1.000
Employment					
Employed	1.185	1.252	1.106	1.532	0.781
Unemployed	1.000	1.000	1.000	1.000	1.000
Ethnicity					
Malay	1.000	–	–	–	–
Chinese	0.928	–	–	–	–
Indian	0.827	–	–	–	–
Others	0.365*	–	–	–	–
Marital status					
Married	1.106	1.279	1.416	0.610	0.541
Widow/divorce	0.690	0.575	1.322	0.370	0.975
Single	1.000	1.000	1.000	1.000	1.000
Smoking					
Smoker	1.438*	1.409*	4.562*	1.037	0.637
Non-smoker	1.000	1.000	1.000	1.000	1.000
Quit smoking					
Intended	1.233	1.390	0.338	0.876	1.949
Unintended	1.000	1.000	1.000	1.000	1.000
Likelihood ratio	554.180*	371.730*	81.210*	36.060*	46.480*
Pearson Chi-squared	2007.100	879.070	398.310	198.830	395.780
Hosmer-Lemeshow	6.970	13.410	11.030	4.480	8.220
Max. VIF	3.790	3.570	3.610	3.740	5.530
Correct prediction	83.40%	81.00%	83.00%	83.10%	91.50%

Note: *$p < 0.05$. The entries for constant and all the variables refer to adjusted odds ratio (aOR). VIF refers to variance inflation factor.
Source: GATS 2011

sociodemographic factors. Only age, gender, education, ethnicity and cigarette smoking have independent effects on awareness of e-cigarette. Findings derived from the total sample are quite similar to those derived from the sample of Malay, Chinese, Indian and Others ethnic groups. Overall, it seems that ethnicity is an important determinant of awareness of e-cigarette, which reflects the importance of cultural and religious factors in preventing smoking-induced diseases. Because of data limitation, the reasons explaining ethnic variations in e-cigarette awareness are still not well-understood. Therefore, an in-depth qualitative study needs to be conducted.

Since there is a paucity of study related to sociodemographic factors associated with awareness of e-cigarette, the discussion of the measured results is in light of previous investigations of factors affecting awareness of chronic illnesses and risk factors. Findings of the present study suggest that older people, especially Malays are less likely to be aware of e-cigarette than younger people, which are in contrast to evidences of past studies pertaining to awareness of diseases.[17–19] In particular, findings of Carpenter et al. showed that older individuals are more aware of Alzheimer's disease than younger individuals.[17] Based on the data of the United Kingdom (UK), awareness of colorectal cancer was found to be higher among older individuals than younger individuals.[18] Likewise, another study found that older individuals display greater knowledge of tuberculosis compared with younger individuals.[19] A plausible explanation for our finding is that older individuals have a poorer understanding skill than younger individuals,[20] and thus could be less likely to seek new health related information, even though they are more aware of their health. Given these findings, government should devote its attention to providing the elderly, particularly those from Malay ethnic group with more information on e-cigarette, instead of youngsters who are from other ethnic groups.

Overall, men are more likely to be aware of e-cigarette than women. Findings derived from the ethnic samples suggest likewise, except Chinese. Since men are more likely to smoke than women,[21,22] their exposure to cigarette related information tends to be greater compared with women. However, these findings contradict those of previous studies related to health knowledge. Using a sample of patients in England, Parmenter et al. identified that men are less likely to be aware of diseases related to poor diet compared with women.[23] In a study conducted in Mexico, male students showed poorer awareness of type-2 diabetes than female students.[24] Similar findings were evidenced by Yardley et al..[17] It can be concluded that although women, in general, have better health knowledge and awareness than men because of their natural family caretaker characteristic,[25] they are unlikely to know about e-cigarette. In terms of policy implications, it seems desirable to educate women from various ethnic groups about the importance of e-cigarette in preventing tobacco smoking-induced diseases. However, such policy should be implemented carefully because it may encourage women who are not current smokers to indulge in smoking.

Among all the ethnic groups, well-educated individuals appear to be more aware of e-cigarette than their less-educated counterparts. These findings are consistent with those of previous studies, which suggested that individuals who have higher academic qualifications are more aware of the risks of smoking,[26,27] harmful effects of second-hand smoke,[28] environmental tobacco smoke,[29] common eye diseases[30] and cardiovascular diseases[31] compared with their peers with lower academic qualifications.

This is simply because well-educated individuals have a better interpreting skill than less-educated individuals. Thereby, they are more capable of acquiring information from various resources. Since e-cigarette was considered to be a new product at the time this survey was conducted, well-educated individuals were more likely to hear about it than less-educated individuals. Moreover, well-educated individuals are usually averse to risks and tend to engage in less risky behaviours compared with less-educated individuals.[32] This could be another factor explaining why people with higher academic qualifications are more likely to know about e-cigarette. In view of these findings, a nationwide policy directed towards promoting awareness of e-cigarette among the less-educated segment of the population may ensure promising results, especially given the fact that less-educated individuals are more likely to smoke ordinary cigarette than well-educated individuals.[21,22] The targeted population should include individuals from all the ethnic backgrounds.

Holding all the sociodemographic factors constant, smoking behaviour is associated with awareness of e-cigarette. Specifically, smokers, especially those from Malay and Chinese ethnic groups are more aware of e-cigarette compared with their counterparts who do not smoke. Perhaps, this is a reflection of the tendency of smokers to look for a safer alternative to ordinary cigarettes. Another possibility is that tobacco cigarette smokers are often advised by medical experts to quit smoking. Therefore, they are likely to hear about e-cigarette. In order to assist government in formulating better policies, further study may want to use a longitudinal data to explore the relationship between awareness of e-cigarette and the tendency to quit ordinary cigarette smoking among smokers.

The present study is the first to our knowledge to shed light on the factors affecting awareness of e-cigarette in a sample of multi-ethnic population. However, a limitation is that all the information obtained in the survey are self-reported, thus they may be characterised with reporting errors. Furthermore, owing to the fact that our data is a cross-sectional data, the causal relationships between sociodemographic factors and awareness of e-cigarette are not well-identified. Moreover, some non-sociodemographic factors, such as being diagnosed with smoking-induced diseases and presence of history of family illnesses are not taken into account for analysis because of data limitation.

Author contributions

YKC conceived and designed the experiments, performed the experiments, analysed and interpreted the data, and wrote the paper. CHT and HKL contributed reagents, materials, analysis tools and data.

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval

This study does not require ethical approval.

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