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## PUBLIC HEALTH RESEARCH

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### Perception about E-Cigarettes in Malaysia: Sociodemographic Correlates

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#### ABSTRACT

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<b>Introduction</b>	The prevalence of e-cigarette smoking is increasing. Many people still have a poor understanding of the risks of e-cigarettes. The purpose of this study is to examine sociodemographic factors associated with the perception that e-cigarettes are less dangerous than regular cigarettes.
<b>Methods</b>	Multivariable logistic regressions are utilised to estimate the effects of sociodemographic factors on the likelihood of having the perception that e-cigarettes are less dangerous than regular cigarettes. A Malaysian nationwide survey that consists of a large sample size (n = 4176) is used for secondary analysis. The survey was conducted in 2011.
<b>Results</b>	Younger age, male gender and high educational level are associated with good perception about e-cigarettes. Older individuals are less likely to think that e-cigarettes are less dangerous than regular cigarettes compared with younger individuals (aOR: 0.971; 95% CI: 0.957, 0.985). Males are more likely to have the perception that e-cigarettes are less dangerous than regular cigarettes relative to females (aOR: 2.302; 95% CI: 1.631, 3.249). Having primary (aOR: 0.171; 95% CI: 0.096, 0.304) or secondary (aOR: 0.447; 95% CI: 0.318, 0.629) educational level rather than tertiary educational level is associated with a reduced likelihood of having the perception that e-cigarettes are less dangerous than regular cigarettes.
<b>Conclusions</b>	Targeted intervention to the high-risk population plays an important role in determining the perception about e-cigarettes. Nationwide health promotion programmes directed toward changing the perception about e-cigarettes among individuals who think that e-cigarettes are less dangerous than regular cigarettes may be effective in lowering the risk of suffering from the currently unknown long-term negative effect of e-cigarettes.
<b>Keywords</b>	e-cigarette - perception - smoking - sociodemographics – tobacco.

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## INTRODUCTION

An e-cigarette is an electronic device that delivers vaporised nicotine to the user.<sup>1,2</sup> The sensations provided by an ordinary cigarette and an e-cigarette are alike, but the e-cigarette does not generate tar and carbon monoxide. The number of adults who smoke e-cigarettes is rising dramatically. In the United States (US), the sales of e-cigarettes were United States Dollar (USD) 1 billion in 2013, and this figure was expected to be tripled in the near future.<sup>1,2</sup> Similar trend was observed in developing countries, such as Malaysia, where the prevalence of e-cigarette smoking increased from 0.8% in 2011 to 3.2% in 2015.<sup>3,4</sup> Gravelly *et al.*<sup>5</sup> conducted the International Tobacco Control Surveys and found that 19% of Malaysians ever tried e-cigarettes and 14% currently smoke e-cigarettes. Goh *et al.*<sup>6</sup> found that 13.8% of university students aged 18-24 years have ever smoked e-cigarettes. Furthermore, Wong *et al.*<sup>7</sup> pointed out that a large proportion of e-cigarette smokers are students and those who work in managerial positions. Several reasons may explain the increase in the prevalence of e-cigarette smoking in Malaysia. Firstly, unlike other developed countries, such as Australia, Japan and Singapore, e-cigarettes are not completely banned in Malaysia.<sup>7</sup> While sales of e-cigarettes are allowed, they are restricted by rules and regulations. Secondly, e-cigarettes were first observed in Malaysia in 2009, which are still new for Malaysian market, thus people may still be uncertain about the adverse effects of e-cigarettes on health.<sup>8</sup>

There is a growing concern in public health circles about the potential health effects of e-cigarettes. However, it is also widely accepted that e-cigarettes are, in fact, less dangerous, and among harm reduction advocates. Therefore, switching to e-cigarettes is recommended for those who are having difficulties in quitting smoking.<sup>9</sup> The reasons why people use e-cigarettes have been examined in several empirical studies.<sup>7,10,11</sup> One of the main reasons is that e-cigarette users have the thought that e-cigarettes are less harmful to health than normal cigarettes. E-cigarette users often believe that e-cigarettes do not have carcinogen and are not combusted, thus they are less dangerous than normal cigarettes. However, the substances inside e-cigarettes are still not well-understood and their long-term effects on health are still ambiguous.<sup>7,12</sup> Pisinger and Dossing,<sup>13</sup> in reviewing studies related to the health effects of e-cigarettes, found that numerous studies have failed to show consistent and long-term positive results of e-cigarettes use. In another review article, e-cigarettes were found to have negative effects on the health of adults, children and infants.<sup>14</sup>

Owing to the fact the long-term effects of e-cigarettes are unclear, it is important to understand which groups of population have or do not have the perception that e-cigarettes are less dangerous than

regular cigarettes. This information is useful for developing health promotion programmes aimed at informing the groups of population which have wrong perception about the currently unknown long-term risks of e-cigarettes. However, studies that acquire this information are not abundant. Wong *et al.*<sup>7</sup> and Goh *et al.*<sup>6</sup> are among a few researchers who investigated factors correlated with the use of e-cigarettes in Malaysia, but they did not study the perception about e-cigarettes.

The main objective of the present study is to examine sociodemographic determinants of the perception that e-cigarettes are less dangerous than normal cigarettes. Obtaining a better understanding of factors influencing the perception about e-cigarettes is essential as it can offer important information to support smoking cessation policy decision-making in Malaysia. Also, it could assist policy makers in formulating a more effective intervention measure aimed at discouraging the use of e-cigarettes in public.

## METHODS

### Data

Respondents were selected from the Global Adult Tobacco Survey (GATS) Malaysia, which was a nationwide survey conducted by the Ministry of Health Malaysia and World Health Organization.<sup>3</sup> The GATS Malaysia is not publicly accessible. In order to obtain the data, researchers need to submit a formal letter of application and a research proposal to the Director General of Health for approval. After the application is approved, the data will be provided by the Institute for Public Health for use in research. The GATS Malaysia was conducted from October to December 2011. Although the GATS Malaysia is not carried out recently, by far it is the latest dataset that has comprehensive information on smoking. The main objective of the GATS Malaysia is to examine smoking behaviours among adults and understand factors affecting tobacco control.

Respondents were sampled using a multistage stratified sampling. In the first stage, 426 enumeration blocks (EBs) were selected from the total 74756 EBs in Malaysia. The selection criteria was based on the Malaysian 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, household members in the selected LQs were randomly selected. All individuals aged 15 years or more regardless of gender and ethnic background were eligible for the survey, except individuals who were institutionalised in hospitals, nursing homes or prisons. As such, smoking behaviour among adults and adolescents could be explored. A total of 5112 respondents were surveyed, but only 4389 responded, which was equivalent to the response rate of 85.86%. Respondents who were missing cases, that is, those who did not respond to all the

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questions, were deleted from the analyses of the present study. The number of observations analysed was 4176 respondents, which was equivalent to 213 (4.85%) missing cases. Since the missing rate was very low (less than 5%), the statistical analyses were unlikely to generate imprecise results.<sup>15</sup>

Interviewers had to obtain written consents from the selected respondents. For respondents aged 16 years or less, written consents from their parents or guardians were necessary. All the protocols were approved by the Medical Research and Ethics Committee of Ministry of Health Malaysia. A pilot test was carried out in urban and rural areas in July 2011. In order to ensure that each question in the questionnaire was valid, face validity was established among the technical staff, researchers and experts. With regard to reliability, the estimated value of Cronbach's alpha was more than 0.7. All the interviewers and supervisors were given training before the survey.

### Dependent variable

Respondents who responded 'yes' to the question 'In your opinion, are e-cigarettes less dangerous to health than regular cigarettes?' were considered to have the perception that e-cigarettes are less dangerous than regular cigarettes.

### Independent variables

Since there is a lack of study examining factors associated with perception about e-cigarette smoking, the independent variables used in the present study were selected based on past studies related to knowledge about health risk factors and diseases.<sup>16-27</sup> In particular, the independent variables comprised age, gender, educational level, employment status, ethnicity, marital status, cigarette smoking, use of e-cigarettes and intention to quit smoking.

Respondents' age was formatted as a continuous variable (in years) in order to allow for a linear relationship between age and the perception about e-cigarettes in the regression. Respondents' educational level was categorised into three categories: primary (<7 years), secondary (7-11 years) and tertiary (>11 years).

Employment status variable was grouped into two categories: employed and unemployed (including student, housewife and retiree). The survey asked respondents about their ethnic group

'What is your ethnic background?' The plausible answers were 'Malay', 'Chinese', 'Indian' and 'Others'. Respondents' marital status was categorised into three categories: married, widowed/divorced and single.

Respondents were coded as smokers if they responded 'yes' to the question 'Do you currently smoke tobacco?' Respondents who reported 'yes' for the question 'Are you currently smoking e-cigarettes?' were considered to be e-cigarette smokers. Only respondents who smoked cigarettes answered this question 'In the last 12 months, have you ever tried to quit smoking?' 'Yes' referred to those who had the intention to quit smoking. This variable can help to identify whether individuals who had the intention to quit smoking were likely to use e-cigarettes as an aid to cease smoking.

### Statistical analyses

Descriptive statistics of all the independent variables were calculated. For age variable, mean and standard deviation were reported. For other variables, frequency and percentage were reported. Pearson's Chi-squared was used as the statistical test of proportions. In terms of multivariable analysis, logistic regressions were utilised to examine the independent effects of sociodemographic factors on the likelihood of having the perception that e-cigarettes are less dangerous than regular cigarettes. The significance level was based on  $p < 0.05$ . All the statistical analyses were performed using Stata statistical software.<sup>28</sup>

## RESULTS

Approximately 8.29% of males thought that e-cigarettes are less dangerous than regular cigarettes. Among individuals with tertiary educational level, 13.90% thought that e-cigarettes are less dangerous than regular cigarettes. The proportion of employed individuals who thought that e-cigarettes are less dangerous than regular cigarettes (7.11%) was greater. Nearly one-tenth of single individuals thought that e-cigarettes are less dangerous than regular cigarettes (9.27%). A larger proportion of smokers (8.72%) and e-cigarette smokers (40%) thought that e-cigarettes are less dangerous than regular cigarettes. Among those who were intended to quit smoking, 11.19% thought that e-cigarettes are less dangerous than regular cigarettes (Table 1).

**Table 1** Summary statistics of independent variables and proportion of respondents who have the perception that e-cigarettes are more or less dangerous than regular cigarettes (n = 4176)

Variables	Total	Less dangerous <sup>#</sup>	More dangerous <sup>#</sup>	p-value <sup>^</sup>
Age	41.33 (16.35)	–	–	–
Gender				
Male	2063 (49.40)	171 (8.29)	1892 (91.71)	<0.001
Female	2113 (50.60)	71 (3.36)	2042 (96.64)	

Education				
Primary	1357 (32.50)	22 (1.62)	1335 (98.38)	<0.001
Secondary	2416 (57.85)	164 (6.79)	2252 (93.21)	
Tertiary	403 (9.65)	56 (13.90)	347 (86.10)	
Employment				
Employed	2307 (55.24)	164 (7.11)	2143 (92.89)	<0.001
Unemployed	1869 (44.76)	78 (4.17)	1791 (95.83)	
Ethnicity				
Malay	2496 (59.77)	164 (6.57)	2332 (93.43)	0.061
Chinese	619 (14.82)	28 (4.52)	591 (95.48)	
India	261 (6.25)	17 (6.51)	244 (93.49)	
Others	800 (19.16)	33 (4.12)	767 (95.88)	
Marital status				
Married	2666 (63.84)	131 (4.91)	2535 (95.09)	<0.001
Widow/divorce	485 (11.61)	16 (3.30)	469 (96.70)	
Single	1025 (24.55)	95 (9.27)	930 (90.73)	
Smoking				
Smoker	975 (23.35)	85 (8.72)	890 (91.28)	<0.001
Non-smoker	3201 (76.65)	157 (4.90)	3044 (95.10)	
e-cigarette				
User	20 (0.48)	8 (40.00)	12 (60.00)	<0.001
Non-user	4156 (99.52)	234 (5.63)	3922 (94.37)	
Quit smoking				
Intended	402 (9.63)	45 (11.19)	357 (88.81)	<0.001
Unintended	3774 (90.37)	197 (5.22)	3577 (94.78)	

Note: For age, the values refer to mean (standard deviation). For other variables, the values refer to frequency (percentage). #Respondents who have the perception that e-cigarettes are more or less dangerous than regular cigarettes. ^p-value is based on Pearson's Chi-squared test of proportion.

Source: GATS 2011

The likelihood ratio (LR) statistics was highly significant, and this showed that all the independent variables were jointly significant in explaining the odds of thinking that e-cigarettes are less dangerous than regular cigarettes. Also, the majority of the outcomes were correctly predicted by the model (94.20%). It could, therefore, be concluded that the model was well-specified. The constant was significant, and this implied that factors other than sociodemographic factors may affect the odds of having the perception that e-cigarettes are less dangerous than regular cigarettes. Age was negatively associated with the odds of having the thought that e-cigarettes are less dangerous than regular cigarettes. Specifically, an additional year of age reduced the odds of having the

perception that e-cigarettes are less dangerous than regular cigarettes by 2.9%. Males had 130.2% higher odds of thinking that e-cigarettes are less dangerous than regular cigarettes compared with females. Individuals with primary and secondary educational levels had 55.3-82.9% lower odds of thinking that e-cigarettes are less dangerous than regular cigarettes compared with their counterparts having tertiary educational level. Compared to Malays, individuals from other ethnic groups had 30.1% lower odds of thinking that e-cigarettes are less dangerous than regular cigarettes. E-cigarette smokers displayed 359.1% higher odds of having the perception that e-cigarettes are less dangerous than regular cigarettes compared to non-e-cigarette smokers (Table 2).

**Table 2** Sociodemographic factors associated with the perception that e-cigarettes are less dangerous than regular cigarettes (n = 4176)

Variables	Numbers	Adjusted OR	95% CI	p-value
Constant	–	0.259*	0.154, 0.435	<0.001
Age	4176	0.971*	0.957, 0.985	<0.001
Gender				
Male	2063	2.302*	1.631, 3.249	<0.001
Female	2113	1.000	–	–
Education				
Primary	1357	0.171*	0.096, 0.304	<0.001
Secondary	2416	0.447*	0.318, 0.629	<0.001

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Tertiary Employment	403	1.000	–	–
Employed	2307	0.916	0.659, 1.274	0.604
Unemployed	1869	1.000	–	–
Ethnicity				
Malay	2496	1.000	–	–
Chinese	619	0.782	0.511, 1.195	0.255
India	261	1.016	0.595, 1.735	0.953
Others	800	0.669*	0.450, 0.997	0.048
Marital status				
Married	2666	1.099	0.762, 1.583	0.614
Widow/divorce	485	1.826	0.943, 3.538	0.074
Single	1025	1.000	–	–
Smoking				
Smoker	975	1.001	0.662, 1.512	0.999
Non-smoker	3201	1.000	–	–
e-cigarette				
User	20	4.591*	1.778, 11.856	0.002
Non-user	4156	1.000	–	–
Quit smoking				
Intended	402	1.541	0.971, 2.444	0.066
Unintended	3774	1.000	–	–
Likelihood ratio		184.060*		
p-value		<0.001		
Predicted (%)		94.20		

Note: \*p<0.05. OR refers to odds ratio. CI refers to confidence interval.

Source: GATS 2011

## DISCUSSION

An increase in the prevalence of e-cigarette smoking has become a public health concern. The present study used nationally representative data to examine factors associated with the perception about e-cigarettes. Results of Pearson's Chi-squared test showed that gender, educational level, employment status, marital status, cigarette smoking, e-cigarette smoking and intention to quit smoking were significantly correlated to the perception that e-cigarettes were less dangerous than regular cigarettes. However, results of multivariable logistic regressions showed that only age (aOR: 0.971), male gender (aOR: 2.302), primary-level education (aOR: 0.171), secondary-level education (aOR: 0.447), Others ethnic group (aOR: 0.669) and e-cigarette smoking (aOR: 4.591) were significant, indicating that only these variables had independent effects on the perception about e-cigarettes. Our findings appear to have important implications for policies which are aimed at discouraging people from using e-cigarettes.

Age was negatively associated with good perception about e-cigarettes. In other words, older individuals were less likely to have the perception that e-cigarettes are less dangerous than regular cigarettes compared to younger individuals. Evidence of previous studies showed age differences in knowledge about diseases.<sup>16-18</sup> Although perception was not equivalent to knowledge, they were comparable. Carpenter et al.<sup>16</sup> found that Alzheimer's Disease Knowledge Scale

was positively associated with age of adults in the US. Yardley et al.<sup>17</sup> using a UK population-based survey identified that older individuals had better knowledge about the symptom of colorectal cancer than younger individuals. There were also findings suggesting that individuals who were in older age groups had higher odds of having high tuberculosis knowledge than those who were in younger age groups.<sup>18</sup> Several reasons may explain these outcomes. First, e-cigarette marketing is common and appears to target young adults. Second, the elderly may not be aware of the latest technology. In light of these findings, government could pay more attention to younger adults than older adults. A public policy that can change the perception about e-cigarettes among younger adults is worthy of consideration.

Being male rather than female seemed to be independently associated with an increased likelihood of having the perception that e-cigarettes are less dangerous than regular cigarettes. Previous studies found that males had poorer health knowledge than females.<sup>17,27,29</sup> A likely explanation for this outcome is that the prevalence of smoking is higher among men than women. The fact that women are more risk-aversion oriented than men could be another plausible contributing factor.<sup>30</sup> Since smoking is a high-risk behaviour, women are more aware of its possible negative effects than men. The present study's finding implies that an intervention measure directed towards changing the

perception about e-cigarettes among males may appear promising.

The relationship between educational level and perception about e-cigarettes is noteworthy. Individuals who had primary or secondary educational level were less likely to have the perception that e-cigarettes are less dangerous than regular cigarettes compared to their counterparts with tertiary educational level. However, previous studies consistently found that well-educated individuals were more aware of the risks of smoking, environmental tobacco smoke, common eye diseases and cardiovascular diseases than less-educated individuals.<sup>19-23</sup> An important implication of our finding is that government could concentrate primarily on changing the perception about e-cigarettes among well-educated segments of the population. A public education programme should not only pay attention to less-educated people but also the well-educated.

Ethnicity is one of the important determinants of the perception about e-cigarettes. Compared to Malays, individuals from other ethnic backgrounds were less likely to have the perception that e-cigarettes are less dangerous than regular cigarettes. Previous findings of Cheah et al.<sup>25</sup> showed that individuals from other ethnic backgrounds were more aware of the adverse effects of second-hand smoke than Chinese. Based on these outcomes, one can conclude that there are cultural and religious differences in the perception about e-cigarettes. A future qualitative study may need to explore these differences in greater detail. In terms of policy implication, government could put more efforts into changing the perception about e-cigarettes among Malays. The government is suggested to use Malay spokespersons to highlight the risks of e-cigarettes.

There was a significant relationship between smoking behaviours and the perception about e-cigarettes. In particular, e-cigarette smokers had a higher likelihood of thinking that e-cigarettes are less dangerous than regular cigarettes compared with non-e-cigarette smokers. Our findings indicate that the perception about the effects of e-cigarettes on health could result in the use of e-cigarettes. Therefore, if a nationwide policy can successfully change the perception about e-cigarettes among e-cigarette smokers, the prevalence of the use of e-cigarettes could be reduced.

The contributions of the present study are numerous. Firstly, this study is the first comprehensive study that examines factors associated with the perception about e-cigarettes. Secondly, findings of the present study are generated from nationally representative data that consist of a large sample size. Thirdly, Malaysia is a developing country where e-cigarettes are not completely banned, and the prevalence of e-cigarette smoking has been increasing.<sup>8</sup>

The present study has several drawbacks because of data limitation. First, the data are self-reported. Hence, minor reporting errors are not avoidable. Second, the causal relationships between sociodemographic factors and the perception about e-cigarettes cannot be identified due to cross-sectional analysis of data. Third, perception may not be the best measure for knowledge of e-cigarettes because there are many questions left unanswered about the long-term health ramification of e-cigarette use among adults. Fourth, the data are old, thus may not reflect the current perception about e-cigarettes in Malaysia. Fifth, although the dependent variable may not be the most appropriate measure for e-cigarette knowledge, it is of high quality for use in research.<sup>31</sup> Moreover, due to data limitation, we could not categorise Others ethnic group into Sabah natives, Sarawak natives and *Orang Asli*.

## CONCLUSIONS

The present study reveals that sociodemographic factors play an important role in influencing the perception about e-cigarettes. People are more likely to have the perception that e-cigarettes are less dangerous than regular cigarettes if they are younger adults, male, well-educated and e-cigarette users. Since e-cigarette use is a modifiable risk factor, policy makers could pay more attention to e-cigarette users. Therefore, the objective of reducing the prevalence of the use of e-cigarettes throughout the country can be met. Besides declaring a ban on e-cigarettes, policy makers could consider educating the public about the negative consequences of e-cigarettes. A future study is suggested to use more recent data to examine factors associated with perception about e-cigarettes, so that the current situation about e-cigarettes use can be better understood.

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