



ORIGINAL ARTICLE

Experimentation and correlates of electronic nicotine delivery system (electronic cigarettes) among university students – A cross sectional study



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Abstract Objective: E-cigarettes are becoming popular among youth as safe nicotine delivery systems. Many have expressed concern, however, that e-cigarettes may serve as a gateway to future smoking, given their low perceived risk, or that their use may prevent regular smokers from quitting by maintaining their nicotine addiction. The aim of this study was to assess experimentation with and correlates of e-cigarette use among university students.

Material and methods: A cross-sectional study was carried out among 480 university students from four faculties at a university in Riyadh in August–October 2014. A modified version of the World Health Organization's Global Adult Tobacco Survey was used, and multinomial logistic regression was carried out to assess correlations with e-cigarette variables in the whole study sample and among smokers.

Results: Almost all students, including the majority of ex-smokers (96.3%) and smokers (94.4%), reported having heard about e-cigarettes. In addition, about one-quarter of the sample (54.2% of smokers, 24.7% of ex-smokers, 6% of never smokers) had experimented with e-cigarettes at least once during their lifetime. Curiosity and peer influence were reported as the main reasons for the use of e-cigarettes. Factors found to be correlated significantly with e-cigarette use were male gender, being a traditional cigarette smoker, having friends who have tried e-cigarettes, and having a strong belief that e-cigarettes could aid smoking cessation.

Conclusion: E-cigarettes are popular among Saudi youth, especially among smokers and ex-smokers. Well-designed health education programs and regulatory interventions are required to address this issue.

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1. Introduction

Electronic nicotine delivery systems, more commonly called electronic cigarettes or e-cigarettes, are battery-operated devices based on an inhalation-activated system that heats a

cartridge, producing vapor that the user inhales. The cartridges contain liquids that consist of various combinations of propylene glycol, glycerin, nicotine, tobacco extracts, flavorants, and/or adulterants. As e-cigarettes do not rely on combustion, users do not expose themselves or others to many of the harmful tobacco smoke constituents and particles produced by regular cigarettes (Benowitz, 2011).

In recent years, the marketing and use of e-cigarettes have increased markedly throughout the world due to manufacturers' claims that these nicotine delivery systems are safe. Safety data, however, are sparse and inconsistent (Bahl et al., 2012; Kuschner et al., 2011; Lee et al., 2011). In addition, many have expressed concerns that the popularity of e-cigarettes among youth because of their low perceived risk may represent a gateway to future smoking (Grana, 2013), or that their use may prevent regular smokers from quitting by maintaining their nicotine addiction (Cobb and Abrams, 2011). Well-designed clinical trials need to be conducted to examine the safety of e-cigarettes and their efficiency in smoking termination.

Due to the lack of safety data and global regulations, as well as the novelty of these products, the performance of clinical trials may be challenging. Until trials can be undertaken, the collection of data on usage patterns through surveys may provide information about the effects of these products on a range of outcomes. Although the e-cigarette literature is expanding rapidly, very few data on the awareness and use of e-cigarettes among youth in Saudi Arabia are available. Hence, the aim of this study was to assess awareness of, beliefs about, and experimentation with e-cigarettes among university students in Saudi Arabia.

2. Material and methods

2.1. Population and study design

This cross-sectional study was conducted in August–October 2014 among university students from four faculties (medical, dental, pharmacy, and engineering) of King Saud University, Riyadh, Saudi Arabia. Participants were given a self-administered questionnaire with detailed instructions for completing it individually. Questionnaires were distributed during breaks from lectures or work. The participants were informed that their participation in the study was voluntary, and they were required to complete the questionnaire on site and to return it immediately to the research team. Standard informed consent procedures, including the protection of participants' anonymity and confidentiality, were used. The institutional research and ethics committees approved the study [FR 0319].

2.2. Instrument and data collection

The questionnaire was developed from the e-cigarette part of the World Health Organization's Global Adult Tobacco Survey (<http://www.cdc.gov/tobacco/global/gats/questionnaire/index.htm> [updated 25 May 2009, accessed June 2009]) and was peer-reviewed, piloted, and determined to be comprehensive. Questionnaire items solicited data on sociodemographic characteristics (age, gender, year of study) and awareness of and beliefs about e-cigarettes. E-cigarette use was assessed by questions concerning use in one's lifetime, reasons for use, use in the last month, intention to use, and experimentation

with e-cigarettes by peers, parents, and/or siblings. The questionnaire also assessed respondents' smoking behavior (smoker [smoked traditional cigarettes in the last month], ex-smoker [smoked in the past but not in the last month], never-smoker [never smoked traditional cigarettes]).

2.3. Data analysis

Data were analyzed using SPSS Inc. (Chicago). Responses were coded as numeric to facilitate data entry. Multinomial logistic regression analysis was carried out to assess correlations with e-cigarette variables in the whole study sample and among smokers. The dependent variable was experimentation with e-cigarettes (never [reference] versus ever during one's lifetime). The independent variables were gender; smoking status (0 = never smoker, 1 = ex-smoker, 2 = smoker); attitudes toward e-cigarettes (e.g., can aid smoking cessation, are less dangerous, only smokers use e-cigarettes; totally disagree/partially disagree/do not know versus totally agree/partially agree); experimentation with e-cigarettes by friends, parents, or siblings (yes versus no); frequency of cigarette smoking (≤ 1 pack/day versus > 1 pack/day); and intention to quit cigarette smoking within the next year (yes versus no). The level of significance was set at $P < 0.05$.

3. Results

A total of 480 students completed the questionnaire (response rate, 89.6%). The majority (63.3%) of participants was male and 36.7% were female, with a mean age of 24.0 ± 1.3 years.

3.1. Awareness, attitudes, and practice

More than one-third (33.8%) of participants were smokers and 16.6% were ex-smokers. Never-smokers comprised about half (50.4%) of the study population. Regarding awareness of e-cigarettes, the majority (93.8%) of participants reported having heard about e-cigarettes (ex-smokers, 96.3%; smokers, 94.4%; never-smokers, 89.3%).

More than half of the students who were aware of e-cigarettes believed that e-cigarettes are less dangerous than traditional cigarettes, with the highest percentage (63.3%) recorded among smokers (Table 1). More than two-thirds of the students reported that e-cigarettes could aid smoking cessation, and almost half of the students reported that only smokers use e-cigarettes.

Regarding the use of e-cigarettes, one-quarter of the study population reported that they had tried e-cigarettes at least once during their lifetimes, with the highest percentage of users (54.2%) found among smokers. Interestingly, no ex-smoker or never smoker reported the use of e-cigarettes in the last month. Curiosity and peer influence were the main reported reasons for ever trying e-cigarettes; only one-third of smokers used these products for smoking cessation.

Almost two-thirds of the study population reported that they had friends who had experimented with e-cigarettes, whereas less than 10% reported that their parents or siblings had used e-cigarettes. The majority (87.5%) of participants reported that they had no intention to use e-cigarettes in the next year; 12.7% of smokers declared their intention to use e-cigarettes in the next year.

3.2. Correlates of experimenting with e-cigarettes

The results of multinomial logistic regression analyses are shown in Table 2. Male students, smokers, and those whose peers who had tried e-cigarettes were more likely to experiment with e-cigarettes. Students who strongly believed that e-cigarettes play an important role in smok-

Table 1 Awareness, attitude and practice of e-cigarettes among the study population.

	Total sample (n = 450*) %	Smokers (n = 153*) %	Ex-smokers (n = 77*) %	Never smokers (n = 216*) %
<i>E-cigarettes are less dangerous</i>				
Totally agree/partially agree	55.8	66.3	33.9	58.9
Do not know	35.6	32.1	47.5	29.2
Totally disagree/partially disagree	8.6	1.6	18.6	11.9
<i>E-cigarettes can help in smoking cessation</i>				
Totally agree/partially agree	67.2	46.9	70.2	78.7
Do not know	21.3	33.2	19.8	15.6
Totally disagree/partially disagree	11.5	19.9	10.0	5.7
<i>Only smokers use e-cigarettes</i>				
Totally agree/partially agree	49.7	51.5	51.2	47.1
Do not know	34.1	31.2	33.1	34.8
Totally disagree/partially disagree	16.2	17.3	15.7	18.1
<i>Experimentation with e-cigarettes</i>				
Used at least once in lifetime	25.6	54.2	24.7	6.0
Used in the last month	3.9	8.9	0	0
<i>Reasons for e-cigarette use**</i>				
E-cigarettes are less dangerous	7.9	0	49.3	0
Reducing traditional cigarette use	0	0	0	–
Smoking cessation	24.3	32.3	0	–
Curiosity	63.4	66.1	50.7	58.4
Peers' influence	23.9	25.4	0	41.6
<i>E-cigarette use among family/social circle</i>				
Friends have used e-cigarette	65.9	67.6	66.5	52.1
Parents have used e-cigarette	7.9	7.4	4.4	6.5
Siblings have used e-cigarette	7.2	5.9	8.6	6.9
<i>Intention to use e-cigarettes in the next year</i>				
Totally agree/partially agree	3.9	12.7	0	0
Do not know	8.6	18.5	4.7	2.2
Totally disagree/partially disagree	87.5	68.8	95.3	97.8

* Include those who heard about e-cigarettes.

** Based on those who experimented with e-cigarettes (smokers = 83; ex-smokers = 19; never smokers = 13).

ing cessation and those who had weaker beliefs that only smokers use e-cigarettes also frequently experimented with e-cigarettes. These variables explained 59% of e-cigarette-related behavior.

Among smokers, experimentation with e-cigarettes was more frequent among male students, those whose peers who had experimented with e-cigarettes, and those who smoked larger numbers of traditional cigarettes. In addition, e-cigarette experimentation was correlated significantly among smokers with strong beliefs that e-cigarettes are less dangerous than traditional cigarettes and that they could aid smoking cessation. No significant association between experimentation with e-cigarettes and the intention to quit traditional smoking in the next year was observed. The amount of variance explained by these variables was 55%.

4. Discussion

To our knowledge, this study is the first to investigate awareness of and experimentation with e-cigarettes among youth in Saudi Arabia. We observed high rates of awareness and experimentation with e-cigarettes among university students in Saudi Arabia. These findings may be the result of the ready availability of these products online, with minimal or no restrictions and regulations.

More than half of the study participants, and the majority of smokers, believed that e-cigarettes are less dangerous than

traditional cigarettes. More than one-quarter of participants were not sure about the safety of e-cigarettes. These results reflect the apparent global ambiguity about the safety of e-cigarettes seen in other studies (Brown et al., 2014; Hiscock et al., 2014; Pepper et al., 2013), which may be explained by the novelty of e-cigarettes and the current lack of safety data.

Almost all students reported that they had heard about e-cigarettes, indicating a high level of awareness. These results are in line with the results of other studies carried out in the United Kingdom and United States, which have also shown high awareness among smokers and non-smokers in the adult population (Brown et al., 2014; Dockrell et al., 2013; Tan and Bigman, 2014; Zhu et al., 2013). Interestingly, half of smokers, but small percentages of ex-smokers and never smokers, had tried e-cigarettes. Furthermore, no ex-smoker or never smoker reported using e-cigarettes in the month before the survey.

In our study, experimentation with e-cigarettes was more frequent among smokers compared with non-smokers and among males compared with females. As smoking among females is culturally unacceptable and considered taboo in Saudi Arabia, we expected that e-cigarettes would be less popular among female participants. These findings are similar to those of a study carried out among university students in Poland, which also showed frequent experimentation with

Table 2 Multinomial regression analyses^{*} showing correlates of e-cigarette experimentation.

Independent variables	Total sample (n = 450) ^{**}		Smokers (n = 153) ^{**}	
	Exp (B)	95% CI	Exp (B)	95% CI
<i>Gender</i>				
Female	1		1	
Male	6.29 ^{***}	2.98–13.24	11.99 ^{***}	3.35–42.90
<i>E-cigarettes help in smoking cessation</i>				
Totally disagree/partially disagree/do not know	1		1	
Totally agree/partially agree	2.95 ^{***}	1.46–5.95	12.09 ^{***}	3.30–44.22
<i>E-cigarettes are less dangerous</i>				
Totally disagree/partially disagree/do not know	1		1	
Totally agree/partially agree	1.70 ^{***}	0.91–3.19	3.55 ^{***}	1.26–9.94
<i>Only smokers use e-cigarettes</i>				
Totally disagree/partially disagree/do not know	1		1	
Totally agree/partially agree	0.43 ^{***}	0.23–0.79	0.69	0.26–1.84
<i>Smoking behavior</i>				
Smokers	1			
Ex-smokers	0.09	0.03–0.24		
Never-smokers	0.02	0.01–0.04		
<i>Frequency of cigarette smoking (per day)</i>				
Up to 1 pack per day				1
More than 1 pack per day			10.85 ^{***}	2.67–44.03
<i>Intention to quit smoking within the next year</i>				
Yes			1	
No			0.374	0.12–1.15
<i>Friends experimented with e-cigarettes</i>				
Yes	1			
No	24.25 ^{***}	9.55–61.55	8.97 ^{***}	2.83–28.44
<i>Parents experimented with e-cigarettes</i>				
Yes	1			
No	0.51	0.15–1.70	0.92	0.21–3.87
<i>Siblings experimented with e-cigarettes</i>				
Yes	1			
No	0.41	0.07–2.24	2.30	0.07–6.92

* Reference were participants who did not experiment with e-cigarettes.

** Consisted of participants who had ever experimented with e-cigarettes.

*** $P < 0.05$.

e-cigarettes among smokers and males (Goniewicz and Zielinska-Danch, 2012).

Independent of smoking status, participants in our study cited curiosity and peer influence as the main reasons for e-cigarette use. However, only one-quarter of smokers reported that they used e-cigarettes to help them quit smoking. A recent study assessing Saudi dental students' knowledge and awareness of tobacco use also showed that peer pressure and substitute activity were among the main perceived reasons for the initiation of cigarette smoking (Awan et al., 2015). The Saudi population is young in general, and youth are generally more interested in trying new trends. In addition, the prevalence of smoking in Saudi Arabia has been reported to be as high as 52.3% (Bassiony, 2009). Therefore, large population-based studies need to be carried out to investigate the use of e-cigarettes among the Saudi youth, more so in light of emerging concerns that nicotine delivery through

e-cigarettes may serve as a gateway to traditional cigarette smoking (Degenhardt et al., 2010).

Regardless of the high risk-taking behavior detected among our study participants, majority of the participants reported that they had no intention to use e-cigarettes in the near future, with the highest percentages found among ex-smokers and never smokers. However, whether this type of response is an isolated finding requires further investigation.

This study has a few limitations. First, our study sample consisted of students from one university in Riyadh, Saudi Arabia, which limits the generalizability of our results to the Saudi population. Second, the sample size did not permit separate analysis of data from males and females. Finally, the cross-sectional study design prohibited the identification of casual relationships. Well-designed population-based studies focusing on gender differences may overcome these limitations.

5. Conclusion

Based on our data, use of e-cigarettes is popular among the Saudi youth. Such popularity may result in the re-normalization of smoking in the Saudi population, leading to increases in the already alarming prevalence of smoking and addiction, or may slow the rate of decline. Well-designed health education programs and regulatory interventions may play an important role in addressing this issue.

Conflict of interest

The authors declare that they have no conflict of interest.

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