Awareness of the Health Effects of Electronic Cigarettes among Students of King Saud University in Al Ahsa, 2019

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Abstract: *Tobacco use is a common problem in Saudi Arabia, but there have been few studies on the use of electronic cigarettes (e-cigarettes) in the country. This study aimed to measure awareness of the health effects of e-cigarettes among students of health-sciences specialties in Saudi Arabia. A cross-sectional study was conducted among male students in King Saud bin Abdulaziz University for Health Sciences, in Al Ahsa. A convenience sample was selected, regardless of students' specialty or academic year. A self-administered, validated questionnaire was used, obtaining age, education level, smoking history, and family history of smoking. Data were analyzed using SPSS software version 21. Overall, 190 questionnaires were distributed while 167 questionnaires were completed (88% response rate).The prevalence of smoking among the respondents was 19.8%, while 3% were ex-smokers. Meanwhile, 2.4% reported using e-cigarettes. Regarding awareness, 41.3% believed that e-cigarettes are less harmful than traditional cigarettes, 4.2% felt that e-cigarettes have no harmful effects, 20.4% thought that e-cigarettes are a healthy alternative to traditional cigarettes or shisha, and 37.1% believed that there was no scientific evidence that e-cigarettes are harmful. The data indicate that health-science students in Saudi Arabia have acceptable awareness of the harmful effects of e-cigarettes. Lower awareness was associated with e-cigarette use.*

Keywords: Awareness, electronic cigarettes, health effects, Saudi Arabia, tobacco

1. Introduction

Electronic nicotine delivery systems, also called "electronic cigarettes" (e-cigarettes), are battery-powered devices that convert liquid (usually comprising nicotine, propylene glycol, glycerin, and flavoring) to a spray or vapor that is inhaled by the smoker. E-cigarettes are an alternative method of obtaining nicotine, which is the addictive substance in tobacco; these cigarettes are designed to resemble ordinary cigarettes, but they do not contain tobacco and do not require a flame to ignite. A US study reported that 15 puffs of an e-cigarette (approximately equivalent to smoking one traditional cigarette) yields 0.025–0.77 mg of nicotine [1]. Additionally, the design and composition of e-cigarettes mean that there is no smoke or smog, such as that produced by traditional cigarettes; further, e-cigarettes do not contain harmful chemicals associated with tobacco, such as carbon dioxide and tar[2]. Smokers who replace traditional cigarettes with e-cigarettes may reduce the damaging health effects they experience by smoking, as e-cigarettes are a less-harmful alternative and can be considered an adjunct to quitting smoking. However, the degree of damage e-cigarettes cause to health remains uncertain. Consequently, until concrete findings are obtained, governments must consider developing laws to restrict smoking using e-cigarettes [2].

Globally, tobacco is one of the most serious threats to public health. There are over one billion smokers worldwide, 80% of whom live in low- and middle-income countries [3]. Further, over seven million people die every year from tobacco use, of which six million use tobacco directly [3]. In 2014, the prevalence of smoking among adults in Saudi Arabia (aged 15 years or more) was 23.7% for males, 1.5% for females; cumulatively comprising 12.2% of the total population [4].This consider higher than other country. Meanwhile, a 2016 study reported that the prevalence of e-cigarette use (vaping) among Saudi Arabian smokers was 68.9%, with 58.7% using e-

cigarettes daily [5]. This study also reported that 13.7% of the respondents felt that vaping is absolutely safe, while 67.5% regarded it as dangerous [5].

The objective of this study is to identify the awareness of e-cigarettes among students of King Saud bin Abdulaziz University (KSAU-HS), and to measure the prevalence of e-cigarettes among this sample.

2. Methods

This study involved a cross-sectional approach. Recruitment was conducted in January2019 in KSAU-HS, Al Ahsa, Saudi Arabia, with a convince-sampling technique employed to recruit male students of any subspecialty and academic year.

Sample size and sampling technique

This study used a one-proportion equation for sample-size calculation, assuming that the prevalence of e-cigarette smoking is 14% [7], and selecting a confidence interval of 95% and a margin of error of 5%.

To determine the overall population, study investigators contacted the students affairs department of KSAU-HS to determine the number of students in each education level (i.e., the level of each degree in terms of the National Qualifications Framework for Higher Education), and also informed the department of the data-collection process that would be employed.

A self-administrated questionnaire was created for this study, after reviewing those used in previous related studies [2, 4]. A family medicine consultant and biostatistics expert then assessed the validity of the questionnaire, and it was modified accordingly. Further, to enhance the validly and reliability a pilot study was conducted among 20 students in the College of Medicine in King Faisal University in Al Ahsa. The final

questionnaire comprises three sections: personal data (nine items), tobacco use (four items), and awareness of the health impacts of e-cigarettes (10 items). The latter section contained 10 true statements regarding the effects of e-smoking, and respondents answered the items using "yes, " "no, " or "I don't know." Awareness scores were determined based on the number of questions each respondent answered correctly. Study investigators supervised the data-collection process, which included distributing the self-administered questionnaires to 167 male students (of various education levels) in the Faculty of Applied Medical Sciences, and then answering any questions or inquiries the students had. Before data collection, the investigators explained the study objective to the participants and ensured that their privacy was maintained during data management.

After collection, data were entered, cleaned, and analyzed using SPSS software. All variables were coded before entry and checked before analysis. Categorical variables were analyzed using proportions, frequencies, and cross tables. A chi-square test was performed on the scores for awareness of the health effects of e-cigarettes. **Inferential statistical significance was based on P values of ≤ 0.05 and 95% confidence intervals. Multivariate** analysis was performed through logistic regression.

Approval of the study proposal was obtained from the Saudi Council of Health Specialties, KSU-Alahsa, before the study was conducted. All of the information obtained from the questionnaire was kept confidential. All students were informed of the study purpose prior to beginning the questionnaire, and informed consent was obtained from all respondents involved in the study. Students were free to refuse participation in the study.

3. Results

The number of questionnaires received was 167 out of (giving a response rate of 88%). The respondents' general characteristics are shown in Table 1. The overall sample ranged in age from 18 to 22 years, and the majority were in level 3(24.1%) or level4 (35.2%) education. Overall, 94.6% of the respondents had excellent educational performance in secondary school, but regarding current university grade point average (GPA), 15% reported "excellent" 26.7% reported "very good" 38.2% reported "good" and 19.8% reported "weak."Further, 12% reported having a chronic disease, with 6%reporting having a

respiratory disease. Regarding smoking history, 19.8% were smokers and 3% were ex-smokers; 44.8% had a family history of smoking, and 3% had an ex-smoker in their family.

Results for measuring the respondents' awareness regarding e-smoking are shown in Table 2. Concerning the harmful effects of e-smoking, 41.3% of the respondents felt that e-smoking is less harmful than is traditional cigarette smoking, 4.2% felt that e-cigarettes have no harmful effects at all, 20.4% felt that e-smoking is a healthy alternative to cigarette or shisha smoking, and 37.1% felt that there is no scientific evidence that e-smoking has harmful effects. However, 69.5% of the respondents said that they were aware of harmful effects of passive smoking of e-cigarettes, 58.7% were aware that e-smoking is an unhealthy habit, 73.1% were aware that e-cigarette smokers have a negative influence on their friends and relatives, and 54.2% felt that pictures and videos of celebrities smoking in media contribute to increasing the prevalence of smoking in society. Overall, 70.1% of respondents showed high average awareness (7–10 out of 10).

Figure 1 illustrates the types of smoking engage in by the respondents, featuring traditional cigarettes, shisha, and e-cigarettes, and the respective prevalence. Overall, the prevalence of cigarette smoking was 12%, that of shisha smoking was 5.4%, and that of vaping was 2.4%. Among the respondents who were smokers, the prevalence of cigarette smoking was 62.5%, that of shisha smoking was 28.1% and that of vaping was 12.5%. None of thee-cigarette smokers engaged in any other type of smoking. Finally, 46.9% of the smokers reported having considered quitting smoking.

The results of bivariate analysis of the scores for awareness of e-smoking are shown in Table 3. This shows that awareness of e-smoking was higher among nonsmokers (75.4%) compared to smokers and ex-smokers (51.4%; P=0.005, OR=2.9). The results of the multivariate analysis, performed through a logistic regression test, of the e-smoking awareness scores are shown in Table 4. These results show that the nonsmokers were 3.7 times more likely to have high awareness of e-smoking than were the smokers and ex-smokers (P=0.006, AOR=3.74, 95%CI 1.45–9.65). This result is adjusted for age, GPA, and family history of smoking.

Table 1: General characteristics of the respondents (n = 167)

Variable	Categories	No.	%
Age (Mis: 6)	18–19Y	76	47.2%
	20–22Y	85	52.8%
Educational level (Mis: 113)	1st–2nd	22	40.8
	3rd or higher	32	59.2%
Educational performance (Mis: 1)	Excellent	157	94.6%
	Very good	8	4.8%
	Good	1	0.6%
GPA (Mis: 36)	100–95	20	15.3%
	94.9–90	35	26.7%
	89.9–85	50	38.2%
	< 85	26	19.8%
Respiratory disease	No	157	94.0%

	Yes	10	6.0%
Chronic disease	No	147	88.0%
	Yes	20	12.0%
Smoker	No	130	77.8%
	Yes	32	19.2%
	Ex-smoker	5	3.0%
FHx of smoking (Mis: 2)	No	86	52.1%
	Yes	74	44.8%
	Ex-smoker	5	3.0%

Note – FHx: family history; GPA: grade point average; Mis: missing data.

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Table 2: Respondents' awareness of the health effects of e-cigarette use (n = 167).

Items	Correct		Incorrect		I don't know	
	No.	%	No.	%	No.	%
Electronic cigarette have less harmful effects than do regular cigarettes.	69	41.3%	50	29.9%	48	28.7%
Electronic cigarettes are not harmful.	132	79.0%	7	4.2%	28	16.8%
Electronic cigarettes are a healthy alternative to traditional cigarettes and shisha smoking.	90	53.9%	34	20.4%	43	25.7%
There are no confirmed medical studies reporting that electronic cigarettes cause long-term health damage.	39	23.4%	62	37.1%	66	39.5%
Electronic cigarettes negatively affect people around the smoker, such as children.	116	69.5%	23	13.8%	28	16.8%
Electronic cigarettes are less likely to cause fires because they do not need lighters.	73	43.7%	51	30.5%	43	25.7%
The use of electronic cigarettes is not suitable for non-smokers, those under the age of 18, and pregnant women.	98	58.7%	31	18.6%	38	22.8%
Electronic cigarettes do not leave a smell, even on clothes.	57	34.1%	70	41.9%	40	24.0%
Smokers directly and negatively affect their friends' health.	122	73.1%	25	15.0%	20	12.0%
Celebrities in the media contribute to the spread of smoking in society	87	52.1%	37	22.2%	43	25.7%
Knowledge score	**Score 7–10**		**117**	**70.1%**		
	Score < 7		**50**	**29.9%**		

Table 3: Results of a bivariate analysis of respondents' scores for awareness of electronic-cigarette smoking

Variable	Categories	Knowledge > 7		Knowledge 7–10		P value	OR
		No. (50)	%	No. (117)	%		
Age (Mis: 6)	18–19*	21	27.6%	55	72.4%	0.68	1.15
	20–22	26	30.6%	59	69.4%		
Education level (Mis: 113)	1*	5	22.7%	17	77.3%	0.49	1.55
	2	10	31.3%	22	68.8%		
Educational Perf. (Mis: 1)	Excellent	46	29.3%	111	70.7%	0.46	0.52
	Good*	4	44.4%	5	55.6%		
GPA (Mis: 36)	100–90*	19	34.5%	36	65.5%	0.39	0.72
	< 90	21	27.6%	55	72.4%		
Respiratory disease	No	48	30.6%	109	69.4%	0.73	1.76
	Yes*	2	20.0%	8	80.0%		
Chronic disease	No	47	32.0%	100	68.0%	0.12	2.66
	Yes*	3	15.0%	17	85.0%		
Smoker	No*	32	24.6%	98	75.4%	0.005	2.90
	Yes or ex-smoker	18	48.6%	19	51.4%		
FHx of smoking (Mis: 2)	No*	28	32.6%	58	67.4%	0.31	0.70
	Hx of smoker or ex-smoker	20	25.3%	59	74.7%		

Note – FHx: family history; GPA: grade point average; Mis: missing data.

Table 4: Multivariate analysis of respondents' scores for awareness of electronic-cigarette smoking

Variable	Categories	B	SE	P value	OR	95% CI	
Age	18–19*	−0.09	0.43	0.84	0.92	0.39	2.13
	20–22						
GPA (Mis: 36)	100–90*	−0.25	0.41	0.55	0.78	0.34	1.74
	< 90						
Smoker	No*	1.32	0.48	0.006	3.74	1.45	9.65
	Yes or ex-smoker						
FHx of smoking (Mis: 2)	No*	−0.51	0.42	0.23	0.6	0.26	1.37
	Hx of smoker or ex-smoker						
Constant		−0.78	0.41	0.058	0.46		
Note – FHx: family history; GPA: grade point average. Neg 2 LL = 143.15 - Cox &Snell R square = 0.067 - Neg R square = 0.096							
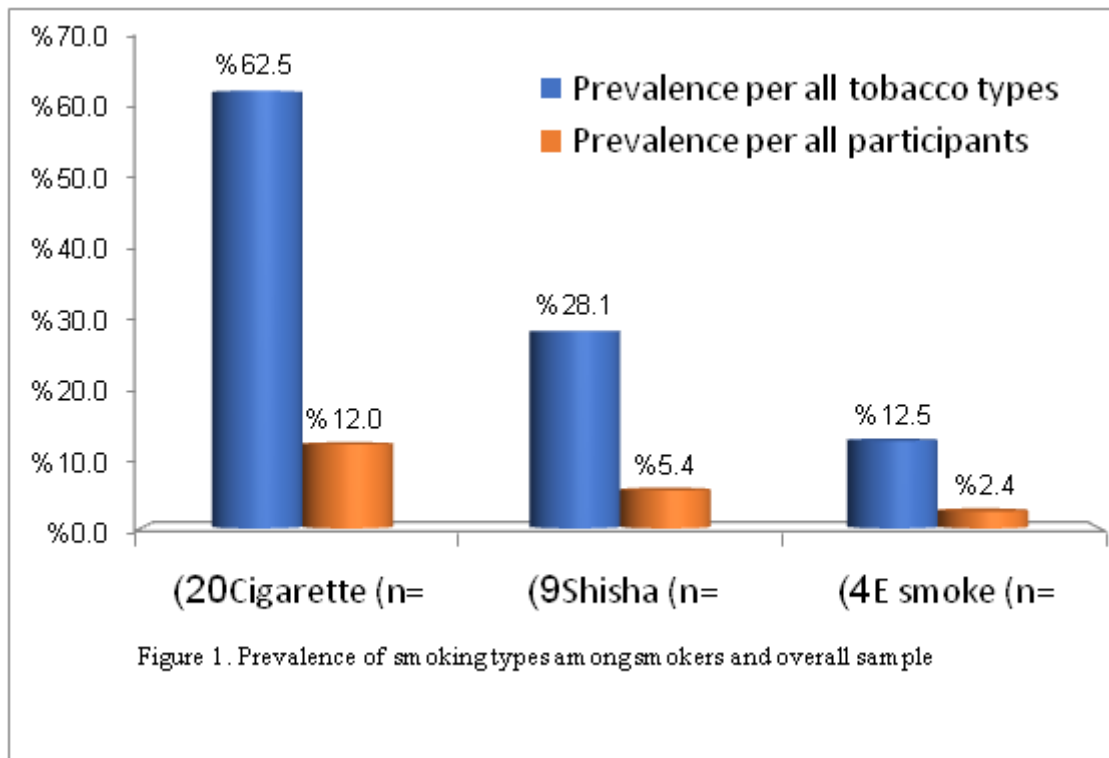
Figure 1. Prevalence of smoking types among smokers and overall sample

4. Discussion

The current study measured the prevalence of e-cigarette use among male university students in Saudi Arabia, and assessed the factors that predict the use of such cigarettes. Considering the overall sample, the prevalence of e-cigarette smoking was 2.4%, and was 12.5% when only smokers were considered. This is a much lower percentage than that reported in previous studies. One 2016 study conducted among smokers in Saudi Arabia reported that the prevalence of e-cigarettes smoking was 68.9%, with 58.7% using e-cigarettes daily [5]. The large difference in these results might be related to differences in methods, population, and setting.

Returning to our study results, over three-quarters of the university students we examined were aware of the harmful effects of e-cigarette smoking, the majorities of smokers believed that e-cigarettes are less dangerous than traditional cigarettes, and over one-quarter of the participants were unsure about the safety of e-cigarettes. This result reflects the apparent ambiguity about the safety of e-cigarettes among the Saudi Arabian public, which has been mentioned in other recent scientific studies conducted in the country [2, 4]. One study conducted in Saudi Arabia reported that 13.7% of participants thought that e-cigarette use is safe, while 67.5% regarded them as dangerous [5].However, the awareness level of e-cigarette smoking in Saudi Arabia has increased from 77.1% in 2012 to 94.3% in 2014, and belief that e-cigarettes are less harmful than regular cigarettes has declined from 50.7% in 2012 to 43.1% in 2014[13]. Global ambiguity regarding the safety of e-cigarettes has also been reported in other studies [8-10], which may be explained by the relative novelty of e-cigarettes and the current lack of safety data.

Among our participants, nonsmokers (75.4%) were more aware of the harmful effects of e-cigarettes than were current smokers and ex-smokers (51.4%). Moreover, 20.4% believed that e-cigarette smoking is a healthy alternative to other types of tobacco use, while 25.7% answered "I do not know" to this item. The abovementioned study conducted among smokers in Saudi Arabia in 2016 reported that 41.6% of the participants

believed that e-cigarette smoking helps smoking cessation, while 31.9% believed that it is less harmful than traditional cigarettes.

The current study found that, among our respondents, 70.1% had high awareness of the health effects of e-cigarettes. Also, most of our respondents had heard of e-cigarettes. These results conform to those of other studies conducted in the United Kingdom and United States, which have also reported high awareness among smokers and non-smokers in the adult population [5, 8, 11, 12]. Such high awareness can be attributed to the availability of health education materials online and in social media, in addition to the fact that all participants were students in medical fields.

Independent of smoking status, the participants in our study reported that curiosity and peer influence were the main reasons for e-cigarette use. However, only one-quarter of the smokers reported using 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 [4].Adolescents and youths are generally interested in trying new trends [4] and, in 2009, the prevalence of smoking in Saudi Arabia was reported as being 52.3% [13].Thus, large population-based studies are necessary to investigate the current use of e-cigarettes among Saudi youths. Such examinations are urgently required in light of emerging concerns that nicotine delivery through e-cigarettes may serve as a gateway to traditional cigarette smoking [7].

Regardless of the high risk-taking behavior detected among our study participants, the majority of the participants reported that they had no intention of using e-cigarettes in the near future, with the highest percentages in this regard found among ex-smokers and non-smokers. However, whether this type of response is an isolated finding or related to other factors requires further investigation.

5. Conclusion

University students in Saudi Arabia have an acceptable level of awareness of the harmful effects of e-cigarettes. Lower awareness is associated with practicing e-cigarette smoking. Further studies on the motivation for smoking e-cigarettes, the harmful effects of passive smoking from e-cigarettes, and cessation issues regarding e-cigarettes are recommended.

6. Future Scope

This study found that increasing awareness is an effective means of preventing e-cigarette use. Increasing the availability of awareness-promoting materials online and in social media, in conjunction with the implementation of national policies and regulations are significant means of preventing tobacco use, including e-cigarette use. Further studies are required to explain the most effective educational methods of increasing awareness levels.

Assessments of the medical, personal, psychological, social, and economic effects of e-cigarettes are necessary. Research that comprises a large and representative sample that includes both genders is required to ensure the validity of the results.

This study has some limitations. First, our study employed a convenience-sampling technique that included only male students from a single university in Al Ahsa. This approach was necessary as a result of certain administrative circumstances and the limited time period available for our project. However, the generalizability of our findings may be limited as a result. Second, the sample was sourced from a health-education institution. The likelihood of receiving knowledge and advice about e-cigarette smoking is higher among such students than amongst those in non-health specialties. Third, the study design was cross-sectional, which is vulnerable to recall bias and cannot identify casual relationships.

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Appendices

Literature Review

1. Pepper et al. (2013, USA).Conducted a cross-sectional study on 228 adolescent males to assess their awareness and willingness to try e-cigarettes. The study reported that most of the adolescent males were aware of and willing to try e-cigarettes [8].

2. Pepper & Brewer (2014, USA).Conducted a systemic review of 49 studies to assess e-cigarette awareness, use, reaction, and beliefs. It reported that e-cigarette use is expanding rapidly, despite experts' concerns about the safety of dual use and its possible gateway effects [9].

3. Palipudi et al.(2016, Indonesia, Malaysia, Qatar, and Greece). Conducted a cross-sectional study, collecting data from Indonesia (2011), Malaysia (2011), Qatar (2013), and Greece (2013). The aim was to compare the awareness of e-cigarettes in high-income countries with that in middle- and low-income countries. It reported that e-cigarette awareness and use is evident in all four countries [10].

4. Huerta, Walker, Mullen, Johnson, & Ford (2017, USA).Conducted a cross-sectional study, collecting data in three cycles (2012 – 2013 – 2014), with analysis performed in 2015. The aim was to assess trends in e-cigarette awareness and perceived harmfulness. It reported a continued increase in overall public awareness of e-cigarettes, but changing perceptions regarding their harmful effects relative to those of regular cigarettes. New regulatory oversight by the U.S. Food and Drug Administration may have major effects on both dimensions, which are worth continued monitoring [11].

5. Karbouji et al. (2018, KSA) Conducted a cross-sectional study on 1, 404 individuals living in Saudi Arabia. The aim was to assess Saudi Arabian smokers' awareness of and attitude toward smoking e-cigarettes. All participants were adult smokers. The sample comprised95% males and 5% females, and had an age range of 18–60 years. The study reported that 68.9% of the samples were using e-cigarettes, with 58.7% admitting to using e-cigarettes daily. Further, 31.1% reported never experienced vaping. Those who thought that vaping is absolutely safe represented 13.7% of the sample; 67.5% regarded it as dangerous [5].

6. Abo-Elkheir & Sobh (2016, Egypt). Conducted a cross-sectional study on 1, 239 members of the Egyptian population, aged 15–75 years, aiming to determine awareness of e-cigarettes. It reported that over half (57.5%) of the respondents had heard of e-cigarettes, 51.8% were non-smokers, and none of the sample reported using e-cigarettes. Meanwhile, 41.6% believed that e-cigarettes help smoking cessation and 31.9% believed that they are less harmful than traditional cigarettes [12].

7. Awan (2016, KSA). Conducted a cross-sectional study on 480 university students from four faculties at a university in Riyadh from August to October 2014. The aim was to assess experimentation with and correlates of e-cigarette use among university students. The study reported that almost all students, including the majority of ex-smokers (96.3%) and smokers (94.4%), had heard of e-cigarettes. In addition, approximately one-quarter of the sample (54.2% of smokers, 24.7% of ex-smokers, 6% of non-smokers) had experimented with e-cigarettes at least once during their lifetimes [13].

Questionnaire

عنوانالدراسة :

مدىوعيطلابجامعةالملكسعودللعلومالصحيةبالأحساءبتأثيرالسيجارةالإلكترونيةعلىالصحة

أوافقعلىالمشاركةفيتعبئةهذاالاستبيانبشرطضمانالحفاظعلىسريةالمعلوماتواستخدامهالغرضالبحثالعلميفقط .
موافق (✓) ◆التاريخ : 14 / /

الجزءالأول :المعلوماتالشخصية
◆**1.1** العمر :سنة
◆**1.2** اسمالكلية (التخصص) :   ◆**1.3** المرحلةالدراسية (المستوىالحالي) :
◆**1.4** تقديرالتحصيلالعلميفيالمرحلةالثانوية : ☐ممتاز☐جيدجدا☐جيد☐مقبول
◆ **1.5** المعدلالتراكميبعدالتخرج (التحصيليوالقدراتوالثانوية) :النسبةالمئوية : ....%
◆**1.6** الجنس :☐ذكر☐أنثى   ◆**1.7** الجنسية :☐سعودي☐غيرسعودي
◆**1.8** هلتشتكيمنأمراضصدريةاوتنفسية؟☐لا☐نعم
◆**1.9** هلتشتكيمنأيمرضمزمن؟☐لا☐نعماذكرها :........................

الجزءالثاني :التدخين
◆ **2.1** هلأنتمدخن؟☐لا☐نعم☐مدخنسابق
◆ **2.2** هليوجدمدخنفيالأسرةالتيتعيشمعها؟☐لا☐نعم☐مدخنسابق
◆ **2.3** نوعالدخانالمستخدم (أجبعلىهذاالجزءإنكنتمدخنا) :-

2.3.1 ☐سيجارة	الكمية :...................سيجارة /يوم	بدأتمنذ : .... سنة
2.3.2 ☐شيشة	الكمية : .... رأس /يوم	بدأتمنذ : .... سنة
2.3.3 ☐سيجارةإلكترونية	الكمية : .... مرة /يوم	بدأتمنذ : .... سنة

◆**2.4** هلحاولتالإقلاععنالتدخين؟☐لا☐نعم
إذاكانتالإجابةنعم :- عددمراتالمحاولة :........................ سببالفشل :........................

الجزءالثالث :معلوماتحولالسيجارةالإلكترونية

الفقرة		موافق	غيرموافق	لاأدري
3.1	ضررالسجائرالإلكترونيةأقلمنضررالسيجارةالعادية.			
3.2	لايوجدأيضرر عنداستخدامالسجائرالإلكترونية.			
3.3	السجائرالإلكترونيةهيالبديلالصحيلمدخنيالسجائرالعاديةوالشيشة.			
3.4	لاتوجددراساتطبيةمؤكدةعنالأضرارصحيةعلىالمدىالبعيدللسجائرالإلكترونية.			
3.5	ضررالسجائرالإلكترونيةيصيبالأشخاصالمحيطينبالمدخنكالأطفالوغيرهم.			
3.6	قللخطرالحرائقلأنالسجائرالإلكترونيةلاتستخدمالولاعات.			
3.7	استخدامالسجائرالإلكترونيةغيرمناسبلغيرالمدخنينولمندونسن 18 وللحوامل.			
3.8	السجائرالإلكترونيةلاتتركرائحةمحتعلىالملابس.			
3.9	المدخنونيؤثرونبشكلمباشر علىأصحابهمفيممارسةالتدخين			
3.10	المشاهيرفيالإعلاميسهمونفيانتشارظاهرةالتدخينفيالمجتمع			