

Knowledge and Awareness Level Among Saudi Population About the Risks of Electronic-Cigarettes in Causing Cardiovascular Diseases

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Abstract

Electronic cigarettes are devices used to provide nicotine to the body, known as Vaping. It was supposed to serve as a way to quit smoking. Those who reported e-cigarette-only use were more likely to report chest pain, palpitations, CAD, and arrhythmia. Furthermore, other studies where e-cigarette use was associated with cardiac conditions such as arrhythmias and hypertension. This study aimed to assess the knowledge and awareness level of the Saudi population about the risks of e-cigarettes in causing cardiovascular diseases. A cross-sectional study was conducted in Saudi Arabia using a self-designed standardized questionnaire. The study included 1062 participants; 57.9% of them were females, and 42.1% were males. 50.4% are aged between 20 and 30 years old. 9.3% of participants were e-cigarette smokers, while 7.6% were tobacco smokers. 8.9% of participants use it for more than one year. 4.7% of participants think that e-cigarettes are safer than regular cigarettes. 55.7% of participants had good knowledge of the effects of e-cigarettes on cardiovascular disease, 39.7% had moderate knowledge, and 4.5% had poor knowledge. The study illustrates that the Saudi population had an acceptable knowledge of the effects of electronic cigarettes on the cardiovascular system. A significant association was found between knowledge scores, age, and gender of participants. This study suggests the need for approaches designed to inform Saudi adults about the potential risks and benefits of e-cigarettes, as well as the dissemination of reliable information or, at the very least, the acknowledgment of the uncertainty regarding the long-term health effects of e-cigarettes.

Keywords: Electronic cigarettes, Vaping, Saudi population, Cardiovascular disease, Risks

INTRODUCTION

Electronic cigarettes are appliances grasped by the hand that provide nicotine to the body through mouth inhalation, often known as Vaping. They warm the fluid containing water propylene-glycol, vegetable-glycerin, flavorings, and nicotine to generate the fume electrically to be inhaled [1]. E-cigarettes are widely used by adults and teenagers. Hence, marketers have recommended them as a safer substitution for tobacco cigarettes [2]. Like tobacco cigarettes, e-cigarettes can cause CVD after prolonged use. The severity of the condition depends more on the length of the exposure period and the nicotine concentrations in e-cigarettes [3]. Nicotine leads to the stimulation of the sympathetic nervous system (SNS), which has an impact on the cardiovascular system. This enhances heart muscle contractions, coronary VC, HR, and HTN [4].

The first e-cigarettes were found in 2004; it was supposed to serve as a way to quit smoking. Smokers who try quitting using e-cigarettes usually end up using them both, which increases the risk of having cardiovascular diseases.

Moreover, e-cigarettes encourage non-smokers to start smoking in the future [5].

There has been some research conducted in Saudi Arabia and other developed countries to determine the prevalence and assess the awareness of using e-cigarettes and their risks. In the Eastern province of Saudi Arabia, a study conducted in

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2019 showed that the prevalence of vaping among the participants was 33.6%, as well as the most common age was between 18-24 [6].

In Saudi Arabia in 2017, another study was conducted showing that 68.9% were using e-cigarettes, with 58.7% admitting to using them daily. 67.5% of the participants regarded it as dangerous [7].

In a University Hospital in Saudi Arabia in 2021, a Cross-sectional study of medical students showed that 36,6% were using e-cigarettes, 13.5% believed that e-cigarettes are FDA-approved for smoking cessation, and the majority (70.7%) were unsure. Moreover, approximately one-third believed e-smoking lowers cancer risks (31.1%) [8].

In 2018, (39,747) worldwide participants participated in a cross-sectional study on e-cigarette dual use with tobacco cigarettes and the risk of cardiopulmonary symptoms. 573 (1.4%) reported using e-cigarettes only, and 514 (1.3%) reported dual use. Those who reported e-cigarette-only use were more likely to report chest pain, palpitations, coronary artery disease, and arrhythmia [9]. This supports findings from other studies where e-cigarette use was associated with cardiac conditions such as arrhythmias and hypertension [10].

The reason for conducting this topic is to clarify the effect of electronic cigarettes because they have become more popular among the general population based on recent studies [11]. Also, Due to the limited number of researches that are related to the awareness of e-cigarettes and their relation to cardiac diseases. The main objective of this study is to assess the knowledge and awareness level of the Saudi population about the risks of e-cigarettes in causing cardiovascular diseases.

MATERIALS AND METHODS

Study Design

This study was a cross-sectional questionnaire survey in Saudi Arabia. This cross-sectional study was conducted between July 2022 and August 2023. The study's population consisted of all Saudi smokers and non-smokers to assess their knowledge about the cardiac risks of electronic cigarettes.

Inclusion and Exclusion Criteria

This study included Saudi people of both genders, male and female, who were aged above 18 years and agreed to participate in this study, while it excluded people younger than 18 years and who disagreed to participate.

Sample Size

The sample size was estimated using the Qualtrics calculator from the total population of 3100008. Considering the standard deviation (=1.96) for a 95% Confidence interval and the maximum acceptable error (=0.05). Therefore, the

calculated minimum sample size required for this study is $n = (1.96)^2 \times 0.50 \times 0.50 / (0.05)^2 = 384$ participants.

$$n = \frac{Z^2 p(1 - p)}{d^2} \tag{1}$$

Method for Data Collection and Instrument (Data Collection Technique and Tools)

Data collection was done using online questionnaires, which were made using Google Forms. They were posted on social media to be spread around. The questionnaire consists of sociodemographic questions such as gender, age, educational level, and whether their occupation is related to healthcare or not. The participants were also asked about e-cigarette habits and their motivation if they were smokers. To assess their knowledge, we added some general questions about e-cigarettes and some specific questions regarding their risk to the cardiovascular system.

Scoring System

The knowledge domain consists of 13 Likert scale items. Participants can specify their degree of agreement with the given statement. A five-point Likert scale was applied for score representation. These would be "Strongly Disagree," "Disagree," "Neutral," "Agree," and "Strongly Agree". Accordingly, numerical scores 1, 2, 3, 4, and 5 were given to them respectively.

The level of knowledge was classified into three levels according to the total scores. Participants who got a score between 0 and 38 (less than 60%) were classified as having a low level of knowledge, and those who got from 39 to 52 (60-79%) were considered to have a moderate level of knowledge and finally for those who got 52 to 65 (80-100%) should have a high level of knowledge.

Analyzes and Entry Method

Data collection was conducted using Microsoft Excel (2016) for Windows. IBM SPSS Statistics for Windows was used for statistical analysis. We used a chi-square test for comparing data, and a p-value of <0.05 was considered to be significant.

RESULTS AND DISCUSSION

The study included 1062 participants; 57.9% of them were females, and 42.1% were males. 50.4% were between 20 and 30 years old, and 20.9% were less than 20. 55.4% had a bachelor's degree, and 27.7% had a high school certificate. 41.6% had occupations related to healthcare (**Table 1**).

Table 1. Sociodemographic characteristics of participants (n=1062)

Parameter	No.	%	
Age	less than 20	222	20.9
	20- 30	535	50.4
	31 -40	145	13.7
	41 -50	120	11.3

Gender	51 -60	40	3.8	Occupation related to healthcare	Lower than a diploma	2	.2
	Male	447	42.1		Diploma	98	9.2
Region	Female	615	57.9	Monthly income	Bachelor	588	55.4
	Northern Borders	25	2.4		Postgraduate	54	5.1
	Al-Baha	50	4.7	Yes	442	41.6	
	Al-Jouf	13	1.2	No	620	58.4	
	Riyadh	114	10.7	less than 3000	550	51.8	
	Qassim	26	2.4	3000-6000	145	13.7	
	Al-Medina	208	19.6	6001-9000	91	8.6	
	Eastern	62	5.8	More than 9000	276	26.0	
	Tabouk	152	14.3				
	Jazan	103	9.7				
Education level	Hail	84	7.9				
	Aseer	13	1.2				
	Makkah	209	19.7				
	Najran	3	.3				
	primary school	9	.8				
	secondary school	17	1.6				
	high school	294	27.7				

Table 2 shows that 47.1% of participants heard about e-cigarettes for the first time from relatives or friends, 38.4% from social media, and 4.1% from tobacco shops. 9.3% of participants were e-cigarette smokers, while 7.6% were tobacco smokers. 8.9% of participants use it for more than one year. 31% believe the value of nicotine content mentioned on the product's label. 4.7% of participants think that e-cigarettes are safer than regular cigarettes.

Table 2. Determinants of E-cigarette use among participants (n=1062)

Parameter	No.	%	
Source of information about electronic cigarettes at first	friends or relatives	500	47.1
	social media	408	38.4
	tobacco shops	44	4.1
	Other	110	10.4
Percentage of friends or relatives smoke e-cigarettes	0-25%	691	65.1
	26%-50%	204	19.2
	51%-75%	121	11.4
	76%-100%	46	4.3
Smoking status	Tobacco cigarettes	81	7.6
	Electronic cigarettes smoker	99	9.3
	Ex-smoker	62	5.8
	non-smoker	790	74.4
Duration of vaping	Other	30	2.8
	less than 6 months	38	3.6
	6 months to 12 months	31	2.9
	Over a year	95	8.9
Inspiration to use the vape	Non-smoker electronic cigarettes	155	14.6
	non-smoker	700	65.9
	Other	43	4.0
	Non-smoker electronic cigarettes safer than regular cigarettes	174	16.4
Believe the value of nicotine content mentioned on the product's label	enjoyment	50	4.7
	curiosity	37	3.5
	simple usage	34	3.2
	quit smoking	29	2.7
	non-smoker	39	3.7
	Other	668	62.9
	Yes	31	2.9
No	329	31.0	
		733	69.0

As illustrated in **Table 3**, 38.7% of participants strongly agree that e-cigarettes are as harmful as regular cigarettes. 46.6%

strongly agree that E-cigarettes are addictive. 44.8% think that E-cigarettes are not less harmful to cardiac health

compared to traditional cigarettes. 44.5% strongly agree that E-cigarettes can cause a heart attack. 46.4% strongly agree that E-cigarettes can cause arterial blockage. 45.1% strongly agree that E-cigarettes can cause hypertension. 47% strongly

agree that E-cigarettes can cause arrhythmia. 46% strongly agree that E-cigarettes can lower oxygen levels and increase blood viscosity.

Table 3. Knowledge of participants of E-cigarettes (n=1062)

	Agree	Strongly agree	Neutral	Disagree	Strongly disagree
E-cigarettes are as harmful as regular cigarettes	222 20.9%	411 38.7%	159 15.0%	166 15.6%	104 9.8%
The use of e-cigarettes should not go beyond smoking cessation.	276 26.0%	363 34.2%	237 22.3%	105 9.9%	81 7.6%
E-cigarettes are addictive	327 30.8%	495 46.6%	142 13.4%	76 7.2%	22 2.1%
E-cigarettes encourage to initiate smoking for non-smokers	322 30.3%	554 52.2%	103 9.7%	58 5.5%	25 2.4%
E-cigarette flavors could be harmful to the health	292 27.5%	541 50.9%	184 17.3%	34 3.2%	11 1.0%
Smoking is a major cause of preventable deaths	284 26.7%	637 60.0%	104 9.8%	23 2.2%	14 1.3%
E-cigarettes are not less harmful to cardiac health compared to traditional cigarettes	276 26.0%	476 44.8%	145 13.7%	104 9.8%	61 5.7%
E-cigarettes affect the cardiovascular system more than the other systems of the body	312 29.4%	486 45.8%	217 20.4%	36 3.4%	11 1.0%
E-cigarettes can cause a heart attack	344 32.4%	473 44.5%	193 18.2%	42 4.0%	10 .9%
E-cigarettes can cause arterial blockage	343 32.3%	493 46.4%	168 15.8%	50 4.7%	8 .8%
E-cigarettes can cause hypertension	375 35.3%	479 45.1%	168 15.8%	30 2.8%	10 .9%
E-cigarettes can cause arrhythmia (abnormality of the heart's rhythm)	392 36.9%	499 47.0%	138 13.0%	27 2.5%	6 .6%
E-cigarettes can lower oxygen levels and increase blood viscosity	356 33.5%	488 46.0%	182 17.1%	28 2.6%	8 .8%

Figure 1 shows that 55.7% of participants had good knowledge of the effects of e-cigarettes on cardiovascular disease, 39.7% had moderate knowledge, and 4.5% had poor knowledge.

Knowledge scores of participants were significantly associated with their age and gender but not with residence area or educational level **Table 4.**

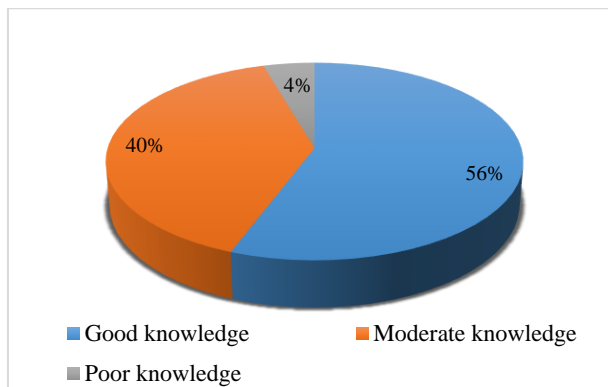


Figure 1. Knowledge score of participants about the risks of e-cigarettes in causing cardiovascular diseases (n=1062)

Table 4. Association between knowledge scores of participants and their sociodemographic characters (n=1062)

		Knowledge score			Total (N=1062)	P value
		Good	Moderate	Poor		
Age	less than 20	127 21.5%	87 20.6%	8 16.7%	222 20.9%	0.012
	20- 30	269 45.4%	237 56.2%	29 60.4%	535 50.4%	
	31 - 40	97 16.4%	42 10.0%	6 12.5%	145 13.7%	
	41 - 50	75 12.7%	43 10.2%	2 4.2%	120 11.3%	
	51 - 60	24 4.1%	13 3.1%	3 6.3%	40 3.8%	
Gender	Male	201 34.0%	212 50.2%	34 70.8%	447 42.1%	0.001
	Female	391 66.0%	210 49.8%	14 29.2%	615 57.9%	
Region	Northern Borders	14 2.4%	9 2.1%	2 4.2%	25 2.4%	0.110
	Al-Baha	35 5.9%	14 3.3%	1 2.1%	50 4.7%	
	Al-Jouf	8 1.4%	5 1.2%	0 0.0%	13 1.2%	
	Riyadh	71 12.0%	36 8.5%	7 14.6%	114 10.7%	
	Qassim	11 1.9%	14 3.3%	1 2.1%	26 2.4%	
	Al-Medina	108 18.2%	94 22.3%	6 12.5%	208 19.6%	
	Eastern	28 4.7%	31 7.3%	3 6.3%	62 5.8%	
	Tabouk	79 13.3%	61 14.5%	12 25.0%	152 14.3%	
	Jazan	64 10.8%	36 8.5%	3 6.3%	103 9.7%	
	Hail.	53 9.0%	29 6.9%	2 4.2%	84 7.9%	
	Aseer.	7 1.2%	6 1.4%	0 0.0%	13 1.2%	
	Makkah	113 19.1%	86 20.4%	10 20.8%	209 19.7%	
	Najran	1 0.2%	1 0.2%	1 2.1%	3 0.3%	
	primary school	5 0.8%	4 0.9%	0 0.0%	9 0.8%	
	secondary school	9 1.5%	8 1.9%	0 0.0%	17 1.6%	
	high school	160 27.0%	119 28.2%	15 31.3%	294 27.7%	
	Lower than a diploma	2 0.3%	0 0.0%	0 0.0%	2 0.2%	
Diploma	51	42	5	98		

		8.6%	10.0%	10.4%	9.2%	
	Bachelor	337	228	23	588	
		56.9%	54.0%	47.9%	55.4%	
	Postgraduate	28	21	5	54	
		4.7%	5.0%	10.4%	5.1%	
Occupation related to healthcare	yes	247	172	23	442	
		41.7%	40.8%	47.9%	41.6%	0.633
	no	345	250	25	620	
		58.3%	59.2%	52.1%	58.4%	
Monthly income	less than 3000	297	229	24	550	
		50.2%	54.3%	50.0%	51.8%	
	3000-6000	82	54	9	145	
		13.9%	12.8%	18.8%	13.7%	0.753
	6001-9000	51	35	5	91	
		8.6%	8.3%	10.4%	8.6%	
	More than 9000	162	104	10	276	
		27.4%	24.6%	20.8%	26.0%	

The research on the short-term effects of e-cigarette usage on the cardiovascular system is equivocal. However, short-term e-cigarette usage is anticipated to be less damaging to the cardiovascular system than smoking traditional cigarettes. Long-term effects on the cardiovascular system are unknown [12]. This study aims to assess the knowledge and awareness level of the Saudi population about the risks of e-cigarettes in causing cardiovascular diseases. 55.7% of participants had good knowledge of the effects of e-cigarettes on cardiovascular disease, 39.7% had moderate knowledge, and 4.5% had poor knowledge.

E-cigarettes are marketed as safer alternatives to combustible tobacco cigarettes, and there is solid evidence that totally substituting e-cigarettes for combustible tobacco cigarettes reduces users' exposure to various toxicants and carcinogens found in combustible tobacco cigarettes [13].

In our study, 9.3% of participants were e-cigarette smokers, while 7.6% were tobacco smokers. 4.7% of participants think that e-cigarettes are safer than regular cigarettes. Previous literature shows strong evidence that transitioning from combustible tobacco cigarettes to e-cigarettes resulted in lower short-term adverse health effects in numerous organ systems. However, combustible tobacco cigarettes are arguably the most dangerous products that can be purchased legally, and while e-cigarettes do not contain tar, one of the most toxic and extensively studied components of cigarettes, they do produce toxic substances, primarily flavors, that are not found in cigarettes and are much less well understood [13, 14].

Numerous research demonstrate that e-cigarette usage has an immediate and negative (increased) influence on vital indicators such as heart rate and blood pressure. In this context, Andrea *et al.* demonstrated that smokers' heart rates

increased abruptly after using e-cigarettes, which was also reported in a second study. Furthermore, Yan *et al.* discovered that e-cigarettes raised both diastolic blood pressure and heart rate in smokers but to a lesser level than tobacco cigarettes [15-18].

Recent literature also discovered that e-cigarettes, even a single usage, are connected with endothelial cell dysfunction and oxidative stress, both of which play essential roles in the etiology of cardiovascular disease. However, the effect was less pronounced when compared to cigarette smoking. In contrast to cigarette smoking, e-cigarette use resulted in a comparable and rapid rise in the number of circulating endothelial progenitor cells, which could be related to acute endothelial dysfunction and/or vascular injury. Given the importance of platelets in the development of cardiovascular disease, a recent in vitro study examined the effects of e-cigarettes on these cells. As a result, e-cigarette vapor extracts were found to increase platelet activation (aggregation and adhesion) in healthy human participants [19-22]. Nevertheless, some researchers have found that short-term use of e-cigarettes causes little cardiovascular risk. These studies discovered that acute e-cigarette use had no immediate effects on coronary circulation, myocardial function, or arterial stiffness. Another study found no significant differences in smokers' heart rates after using e-cigarettes for a short period of time. However, the disparity in findings should be viewed in light of studies demonstrating that vaping topography (e-cigarette usage patterns such as inhalation length and the quantity of inhaled volume) and user experience are significant factors in determining the health impacts of e-cigarettes [23-25].

It is challenging to draw conclusions about the effects of e-cigarettes on cardiovascular health because of the variance in the results, aside from the user's experience and vaping topography, which might be linked to disparities in sample

size, study groups (former smokers versus non-smokers), exposure's nature (acute versus chronic exposure), and a large variety of e-cigarette brands. Of note, the long-term effects of e-cigarettes have not been explored, nor has the mechanism(s) through which they exert their effects on the cardiovascular system [15, 26, 27].

The assumption that e-cigarettes might be a safer alternative to tobacco is supported and promoted by some research. However, it is crucial to take into account (and address) the public safety of these devices for non-users who are nearby and might be exposed to secondhand vaping [25]. The question of whether e-cigarettes constitute a source of secondhand or third-hand vapors was looked into in light of the fact that secondhand and even third-hand exposure to tobacco smoke has harmful effects, notably on the cardiovascular system. E-cigarettes are not an emission-free device, as later investigations amply demonstrated; rather, they have a negative impact on indoor air quality. Particularly, it was discovered that vaping electronic cigarettes releases a number of potentially harmful substances [28].

Though indoor e-cigarette usage was found to produce fewer levels of "secondhand and third-hand" residues than tobacco smoke, these dangers nevertheless constitute a concern to the health of individuals who are unintentionally exposed (non-users). The latter idea should be taken into account in light of survey results showing that users of electronic cigarettes vape in smoke-free locations despite (sadly) not believing that the rules that forbid tobacco use apply to them. This is consistent with results from a different poll that indicated many middle- and high-school children have been exposed to secondhand vaporizers. Research should be conducted to determine the health impacts of second- and third-hand vaping. This information would then be used to develop (stricter) e-cigarette legislation [29-32].

CONCLUSION

The study illustrates that the Saudi population had an acceptable knowledge of the effects of electronic cigarettes on the cardiovascular system. A significant association was found between knowledge scores, age, and gender of participants. This study suggests the need for approaches designed to inform Saudi adults about the potential risks and benefits of e-cigarettes, as well as the dissemination of reliable information or, at the very least, the acknowledgment of the uncertainty regarding the long-term health effects of e-cigarettes. Additionally, it shows that lobbying and ongoing monitoring of the e-cigarette industry's marketing strategies are required.

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Jeddah, Saudi Arabia (Ethical approval number: A01700). Participants were informed that their participation was voluntary and that filling out the questionnaire indicated their consent to participate.

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