

Prevalence, Risk Factors, and Awareness of Electronic-Cigarette Use among Medical Students at King Khalid University, Saudi Arabia

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Abstract

Objectives: To determine the prevalence, pattern of smoking, and associated factors as well as attitudes toward E-cigarettes among medical students.

Methods: A cross-sectional study was conducted among 340 medical students. An online questionnaire was used in data collection. It consists of socio-demographic characteristics, smoking history, awareness of E-cigarettes, the prevalence of their use, beliefs regarding E-cigarettes, and reasons for E-cigarette use

Results: Males represented 58.8%, with a mean age of 22.4±1.5 years. The prevalence of current smoking and ex-smoking among participants was 13.5% and 9.1%, respectively. Most participants have heard of E-cigarettes (94.4%); female students have heard about E-cigarettes more than males (99.3% vs. 91%, respectively, $p<0.001$); 36.8% of participants have tried using E-cigarettes at least once during their lifetime, 15.9% have used them during the last month and 11.8% intended to use them in the next year. Junior students were likelier to try E-cigarettes during their lifetime (44.5% vs. 32.1%, respectively, $p=0.020$). The commonest reasons for trying E-cigarettes were reducing the number of traditional cigarettes (93.6%), being less dangerous than traditional cigarettes (87.2%), and as an attempt to quit smoking (84.8%).

Conclusions: E-cigarettes are tried by a considerable proportion of medical students, mainly to reduce the number of traditional cigarettes, assuming that they are less dangerous than traditional cigarettes, and as an attempt to quit smoking.

Key Words: Cigarette smoking, E-smoking, medical students, knowledge, attitude, risk factors.

Introduction

Tobacco smoking is one of the largest public health threats that face the world. It kills around 6 million people every year. More than 5 million of those deaths are due to direct tobacco use, while more than 600,000 are the result of non-smokers being exposed to second-hand smoke. It has been practiced by over one billion people all over the world, most of them in the developing world. Most smokers start smoking during adolescence or early adulthood. Some behavioral research indicated that adolescents begin their smoking habits as a result of peer pressure, and cultural influence (1).

Tobacco smoking causes diseases that directly affect the heart and lungs. Moreover, smoking is a major risk factor for other health problems, such as heart attacks, strokes, chronic obstructive pulmonary disease (COPD), emphysema, and cancer, mainly lung cancer, cancers of the larynx and mouth, esophageal cancer, bladder and pancreatic cancer (2).

In the Kingdom of Saudi Arabia (KSA), the prevalence of traditional cigarette smoking among male medical students has been reported in previous studies and shown to range from 13% in central Saudi Arabia (3) to 30.4% in Majmaah (4). In contrast, for females, the prevalence was 0.32% (5). Overall, despite that more than 7 thousand Saudis are killed by tobacco-related diseases, more than twenty thousand children and more than three million adults continue to smoke tobacco daily (6).

Electronic cigarettes (E-cigarettes) have been recently introduced to the country with little known about their prevalence or pattern of utilization among medical students in Saudi Arabia. Recently, a study among health science students reported a prevalence of 27.7% (7). The E-cigarette is an electronic emit-vapor device that delivers nicotine in an aerosol form. It consists of a battery, mouthpiece, an automatic or manual switch, a cartridge, and an atomizer with a heating element that contains a solution "e-liquids" which contain propylene glycol or glycerol (or both) and can contain nicotine, flavors, and additives (8).

The main concern is the availability of E-cigarettes with sweet flavors for the young population, which simulate smoking behavior as well as facilitate addiction to nicotine, which consequently leads to the use of traditional tobacco smoking (9, 10).

It is documented that E-cigarettes have been proven to cause addiction (11). Additionally, the risks of prolonged exposure to vapors chemicals of E-cigarettes which contain toxic substances, including formaldehyde, have not been reported (12). Moreover, the effect of E-cigarettes on the health of human beings is still under investigation (13).

Aim of study

To explore the magnitude and predictors of E-cigarette smoking among medical students and to determine their attitude toward it.

Specific objectives

- To determine the prevalence and patterns of E-cigarettes smoking among medical students,
- To define the risk factors associated with E-cigarette smoking among medical students,
- To explore their attitude toward the benefits, safety, and efficacy of E-cigarettes, compared to traditional cigarettes.

Subjects and Methods

The present study followed a cross-sectional research design. It was conducted at the Medical College of King Khalid University (KKU) in Abha City, Saudi Arabia. Medical students (males and females) enrolled throughout the academic year 2019-2020 (approximately 1600 students; 1000 males and 600 females) constituted the study's target population. No exclusion criteria were considered.

The minimum sample size for this study has been estimated according to Dahiru et al. (14), as follows: $n = Z^2 \times P \times Q / D^2$, where:

- n: Calculated sample size
- Z: The z-value for the selected level of confidence = 1.96.
- P: Estimated prevalence of e-cigarette use among university students = 27.7%, (7).
- Q: $(1 - P) = 72.3\%$, i.e., 0.723
- D: The maximum acceptable error [precision level] = 0.05.

$$n = (1.96^2 \times 0.277 \times 0.723) / 0.05^2 = 308$$

Therefore, the calculated minimum sample size for this study was 308 medical students. However, the study sample was increased to 340 students to compensate for possible non- or incomplete responses. A stratified random sample with proportional allocation was adopted. A simple random sampling technique was applied to select subjects from each academic level using a list of students' names obtained from the college administration.

A self-administered questionnaire (in English) was used for data collection, which has been used in a similar study carried out in Romania (15). Permission to use the questionnaire was requested from the corresponding author through e-mail communications. It consists of:

- Socio-demographic characteristics: Age, gender, and academic level.
- Smoking history.
- Awareness toward E-cigarettes (8 statements with Yes/ No responses)
- Prevalence of E-cigarette use (6 statements with yes, neutral, and no responses)
- Beliefs in E-cigarettes (3 statements with a 5-Likert scale response; totally agree, somewhat agree, neutral, somewhat disagree, totally disagree)
- Reasons for E-cigarette use

The questionnaire was validated by three family medicine consultants (face and content validity). A pilot study was conducted on 30 medical students to explore the clarity of included statements and the average time needed to fill out the questionnaire. Their responses were not included in the final research, although no significant changes were required; the questionnaire was clear and no changes were made.

The data were collected through an online survey distributed to the randomly selected medical students through Google Forms. The link to the questionnaire was sent to them through their WhatsApp accounts.

Ethical considerations

The study proposal was approved by the Regional Research and Ethics Committee in KKU (ECM#2020-3209, on 24/12/2020). The permission to conduct the study at the College of Medicine was obtained from the college dean. The study purpose was clearly and briefly explained on the cover page of the online form of the questionnaire. All participants were informed that they had the full right not to participate in the study or to withdraw from it before completion. Confidentiality and privacy were guaranteed for all collected data.

Data entry and statistical analysis

Collected data were verified and then coded. The Statistical Package for Social Sciences (IBM, SPSS, version 25) was used for data analysis. Descriptive statistics (e.g., number, percentage, mean, and standard deviation) and inferential statistics (e.g., Chi-square " χ^2 " or Fisher exact - tests were applied). P-values <0.05 were considered as statistically significant.

Results

Table (1) summarizes their demographic characteristics. Males represented 58.8% of them. Their age ranged between 19 and 27 years with a mean of 22.4 ± 1.5 years. Sixth-year students (11th and 12th levels) represented 22.3% of participants, whereas 2nd-year students (3rd and 4th levels) represented 16.5% of them.

Smoking history

Prevalence rates of current smoking and ex-smoking among the participants were 13.5% and 9.1%, respectively. Among current smokers, 82.6% reported smoking a maximum of one packet/day. Almost three-quarters (73.9%) of current smokers had intention to quit smoking in the next year.

Medical students' awareness of E-cigarettes

Table (2) shows that the majority of participants (94.4%) have heard about E-cigarettes. They were mostly aware that an E-cigarette is a nicotine delivery system (90.3%) and an E-cigarette vaporizes nicotine (84.7%). However, about a third of them were aware that an E-cigarette is not currently regulated by the Food and Drug Administration (39.1%), there is no combustion in an E-cigarette (36.5%), and that carbon monoxide is not emitted from an E-cigarette

(33.2%). Female students have heard about E-cigarettes slightly more than male students (99.3% vs. 91%), were more aware that an E-cigarette is a nicotine delivery system (97.1% vs. 85.5%), an E-cigarette vaporizes nicotine (92.9% vs. 79%), and there is no carbon monoxide in E-cigarettes (45% vs. 25%). Also, female students were more aware than male students that an E-cigarette is not currently regulated by the Food and Drug Administration (48.6% vs. 32.5%). On the other hand, male students were more aware than female students that an E-cigarette can be smoked with different additives (70.5% vs. 50.7%) and an E-cigarette can be smoked with different flavors (68.5% vs. 47.9%).

Table (3) shows that never-smokers and current smokers were more aware than ex-smokers that an E-cigarette is a nicotine delivery system (91.6% and 91.3% vs. 77.4%, respectively, $p=0.040$). Ex-smokers and current smokers were more aware than never-smokers that an E-cigarette can be smoked with different additives (83.9% and 76.1% vs. 57.4%, respectively, $p=0.002$). Also, ex-smokers and current smokers were more aware than never-smokers that an E-cigarette can be smoked with different flavors (80.6% and 76.1% vs. 54%, respectively, $p=0.001$) and there is no combustion in an E-cigarette (61.3% and 50% vs. 31.2%, $p=0.001$).

Table (4) shows no statistically significant difference between junior students (second and third years) and senior students (4th to 6th years) concerning their awareness of E-cigarettes.

Prevalence of e-cigarette use

Table (5) shows that 36.8% of participant students have tried using E-cigarettes at least once during their lifetime, 15.9% have used them in the last month and 11.8% intend to use them in the next year. About half of the students (49.4%) have friends, 5.9% have parents and 32.4% have siblings who have tried smoking E-cigarettes.

Table (6) shows that male students were more likely than female students to have friends who tried E-cigarettes (55% vs. 41.4%, $p=0.046$).

Table (7) shows that there were no statistically significant differences between students regarding e-cigarette use according to their current smoking status.

Table (8) shows that junior students were more likely than senior students to try E-cigarettes at least once during their lifetime (44.5% vs. 32.1%, $p=0.020$) and intended to use E-cigarettes in the next year (18.8% vs. 7.5%, $p=0.008$), while senior students were more likely than junior students to have siblings who have tried E-cigarettes (34% vs. 29.7%, $p=0.018$).

Table (9) shows that there were statistically significant associations between a history of trying E-cigarettes and having such a history among parents or siblings ($p<0.001$ for both).

Beliefs regarding e-cigarettes

Table (10) shows that more than half of the participants either totally agreed or somewhat agreed that E-cigarettes can help smokers quit, and that E-cigarettes are less dangerous than traditional cigarettes (54.4% and 50.6%, respectively), whereas 26.2% either totally agreed or somewhat agreed that E-cigarettes are used only by smokers.

Table (11) shows no statistically significant differences between medical students concerning their beliefs regarding E-cigarettes according to their gender.

Table (12) shows no statistically significant differences between medical students concerning their beliefs regarding E-cigarettes according to their current smoking status.

Table (13) shows no statistically significant differences between junior and senior students concerning their beliefs regarding E-cigarettes.

Reasons for trying E-cigarettes

Figure (1) shows that, among medical students who ever tried E-cigarettes (n=125), the commonest reported reasons were reducing the number of traditional cigarettes (93.6%), believing that they are less dangerous than traditional cigarettes (87.2%) and as an attempt to quit smoking (84.8%).

Table 1: Demographic characteristics of participant medical students at King Khalid University during the academic year 2019-2020

	Frequency	Percentage
Gender		
• Male	200	58.8
• Female	140	41.2
Age (years)		
• Range	19-27	
• Mean±SD	22.4±1.5	
Academic year/level		
• Second year (3 rd and 4 th levels)	56	16.5
• Third year (5 th and 6 th levels)	72	21.2
• Fourth year (7 th and 8 th levels)	71	20.9
• Fifth year (9 th and 10 th levels)	65	19.1
• Sixth year (11 th and 12 th levels)	76	22.3

Table 2: Medical students' awareness about E-cigarettes according to their gender

Awareness about E-cigarettes	Males (n=200)	Females (n=140)	Total (n=340)	P Value
	No. (%)	No. (%)	No. (%)	
Have you heard about E-cigarettes?	182 (91.0)	139 (99.3)	321 (94.4)	<0.001*
Are you aware that an E-cigarette is a nicotine delivery system?	171 (85.5)	136 (97.1)	307 (90.3)	<0.001*
Are you aware that an E-cigarette is an appliance that vaporizes nicotine?	158 (79.0)	130 (92.9)	288 (84.7)	<0.001*
Are you aware that an E-cigarette can be smoked with different additives (i.e., nicotine)?	141 (70.5)	71 (50.7)	212 (62.4)	<0.001*
Are you aware that an E-cigarette can be smoked with different flavors (i.e., peach)?	135 (68.5)	67 (47.9)	202 (59.4)	<0.001*
Are you aware that there is no combustion in an E-cigarette?	74 (37.0)	50 (35.7)	124 (36.5)	0.808*
Are you aware that there is no carbon monoxide in an E-cigarette?	50 (25.0)	63 (45.0)	113 (33.2)	<0.001*
Are you aware that the FDA does not currently regulate E-cigarettes?	65 (32.5)	68 (48.6)	133 (39.1)	0.003*

*Fisher exact test

†Chi-square test

Table 3: Medical students' awareness about E-cigarettes according to their smoking status

Awareness about E-cigarettes	Never smoker (n=263)	Current smoker (n=46)	Ex-smoker (n=31)	P Value†
	No. (%)	No. (%)	No. (%)	
Have you heard about E-cigarettes?	251 (95.4)	41 (89.1)	29 (93.5)	0.223
Are you aware that an E-cigarette is a nicotine delivery system?	241 (91.6)	42 (91.3)	24 (77.4)	0.040
Are you aware that an E-cigarette is an appliance that vaporizes nicotine?	220 (83.7)	43 (93.5)	25 (80.6)	0.187
Are you aware that an E-cigarette can be smoked with different additives (i.e., nicotine)?	151 (57.4)	35 (76.1)	26 (83.9)	0.002
Are you aware that an E-cigarette can be smoked with different flavors (i.e., peach)?	142 (54.0)	35 (76.1)	25 (80.6)	0.001
Are you aware that there is no combustion in an E-cigarette?	82 (31.2)	23 (50.0)	19 (61.3)	0.001
Are you aware that there is no carbon monoxide in an E-cigarette?	263 (33.1)	13 (28.3)	13 (41.9)	0.455
Are you aware that the FDA does not currently regulate E-cigarettes?	99 (37.6)	20 (43.5)	14 (45.2)	0.582

†Chi-square test

Table 4: Comparison between junior and senior students regarding their awareness about E-cigarettes

Awareness about E-cigarettes	Junior (n=128)	Senior (n=212)	P Value†
	No. (%)	No. (%)	
Have you heard about E-cigarettes?	124 (96.9)	197 (92.9)	0.095
Are you aware that an E-cigarette is a nicotine delivery system?	117 (91.4)	190 (89.6)	0.590
Are you aware that an E-cigarette is an appliance that vaporizes nicotine?	112 (87.5)	176 (83.0)	0.266
Are you aware that an E-cigarette can be smoked with different additives (i.e., nicotine)?	75 (58.6)	137 (64.6)	0.266
Are you aware that an E-cigarette can be smoked with different flavors (i.e., peach)?	75 (58.6)	127 (59.9)	0.811
Are you aware that there is no combustion in an E-cigarette?	50 (39.1)	74 (34.9)	0.440
Are you aware that there is no carbon monoxide in an E-cigarette?	46 (35.9)	67 (31.6)	0.411
Are you aware that the FDA does not currently regulate E-cigarettes?	47 (36.7)	86 (40.6)	0.481

†Chi-square test Junior: 2nd and 3rd years Senior: From 4th to 6th years

Table 5: E-cigarette use among medical students

E-cigarettes use	Yes No. (%)	Neutral No. (%)	No No. (%)
At least once during my lifetime	125 (36.8)	28 (8.2)	187 (55.0)
During the last month	54 (15.9)	19 (5.6)	267 (78.5)
I intend to use E-cigarettes next year	40 (11.8)	34 (10.0)	266 (78.2)
Having friends who tried E-cigarettes	168 (49.4)	30 (8.8)	142 (41.8)
Having parents who tried E-cigarettes	20 (5.9)	84 (24.7)	236 (69.4)
Having siblings who tried E-cigarettes	110 (32.4)	55 (16.2)	175 (51.5)

Table 6: E-cigarette use among medical students according to their gender

E-cigarettes use	Males (n=200) No. (%)	Females (n=140) No. (%)	P-value†
At least once during my lifetime	70 (35.0)	55 (39.3)	0.502
During the last month	36 (18.0)	18 (12.9)	0.442
I intend to use E-cigarettes next year	26 (13.0)	14 (10.0)	0.335
Having friends who tried E-cigarettes	110 (55.0)	58 (41.4)	0.046
Having parents who tried E-cigarettes	14 (7.0)	6 (4.3)	0.517
Having siblings who tried E-cigarettes	68 (34.0)	42 (30.0)	0.265

†Chi-square test

Table 7: E-cigarette use among medical students according to their current smoking status

E-cigarettes use	Never smoker (n=263) No. (%)	Current smoker (n=46) No. (%)	Ex-smoker (n=31) No. (%)	P value†
At least once during my lifetime	93 (35.4)	16 (34.8)	16 (51.6)	0.473
During the last month	36 (13.7)	12 (26.1)	6 (19.4)	0.160
I intend to use E-cigarettes next year	28 (10.6)	5 (10.9)	7 (22.6)	0.332
Having friends who tried E-cigarettes	123 (46.8)	25 (54.3)	20 (64.5)	0.166
Having parents who tried E-cigarettes	14 (5.3)	2 (4.3)	4 (12.9)	0.397
Having siblings who tried E-cigarettes	79 (30.0)	18 (39.1)	13 (41.9)	0.174

†Chi-square test

Table 8: Comparison between junior and senior medical students regarding E-cigarettes use

E-cigarettes use	Junior (n=128) No. (%)	Senior (n=212) No. (%)	P-value†
At least once during my lifetime	57 (44.5)	68 (32.1)	0.020
During the last month	24 (18.8)	30 (14.2)	0.314
I intend to use E-cigarettes next year	24 (18.8)	16 (7.5)	0.008
Having friends who tried E-cigarettes	53 (41.4)	115 (54.2)	0.067
Having parents who tried E-cigarettes	6 (4.7)	14 (6.6)	0.086
Having siblings who tried E-cigarettes	38 (29.7)	72 (34.0)	0.018

†Chi-square test

Table 9: E-cigarette use among medical students according to their family history of trying E-cigarette smoking

E-cigarettes use	No No. (%)	Yes No. (%)	Neutral No. (%)	P value†
Having parents who tried E-cigarettes				
No (n=236)	141 (59.7)	82 (34.7)	13 (5.5)	<0.001
Yes (n=20)	5 (25.0)	9 (45.0)	6 (30.0)	
Neutral (n=84)	41 (48.8)	34 (40.5)	9 (10.7)	
Having siblings who tried E-cigarettes				
No (n=175)	119 (68.0)	44 (25.1)	12 (6.9)	<0.001
Yes (n=110)	40 (36.4)	61 (55.5)	9 (8.2)	
Neutral (n=55)	28 (50.9)	20 (36.4)	7 (12.7)	

†Chi-square test

Table 10: Beliefs regarding E-cigarettes among medical students

Beliefs regarding E-cigarettes	Completely Agree No. (%)	Somewhat Agree No. (%)	Neutral No. (%)	Somewhat Disagree No. (%)	Completely disagree No. (%)
E-cigarettes are less dangerous than traditional cigarettes	66 (19.4)	106 (31.2)	104 (30.6)	44 (12.9)	20 (5.9)
E-cigarettes can help smokers to quit	83 (24.4)	102 (30.0)	110 (32.4)	24 (7.1)	21 (6.2)
E-cigarettes are used only by smokers	22 (6.5)	67 (19.7)	109 (32.1)	87 (25.6)	55 (16.2)

Table 11: Medical students' beliefs regarding E-cigarettes use according to their gender

Beliefs regarding E-cigarettes	Males (n=200) No. (%)	Females (n=140) No. (%)	P value†
E-cigarettes are less dangerous than traditional cigarettes	101 (50.5)	71 (50.7)	0.917
E-cigarettes can help smokers to quit	114 (57.0)	71 (50.7)	0.286
E-cigarettes are used only by smokers	50 (25.0)	39 (27.9)	0.474

†Chi-square test

Table 12: Medical students' beliefs regarding E- cigarettes according to their current smoking status

Beliefs regarding E-cigarettes	Never smoker (n=263) No. (%)	Current smoker (n=46) No. (%)	Ex-smoker (n=31) No. (%)	P value†
E-cigarettes are less dangerous than traditional cigarettes	135 (51.3)	25 (54.3)	12 (38.7)	0.093
E-cigarettes can help smokers to quit	143 (54.4)	27 (58.7)	15 (48.4)	0.744
E-cigarettes are used only by smokers	67 (25.5)	13 (28.3)	9 (29.0)	0.958

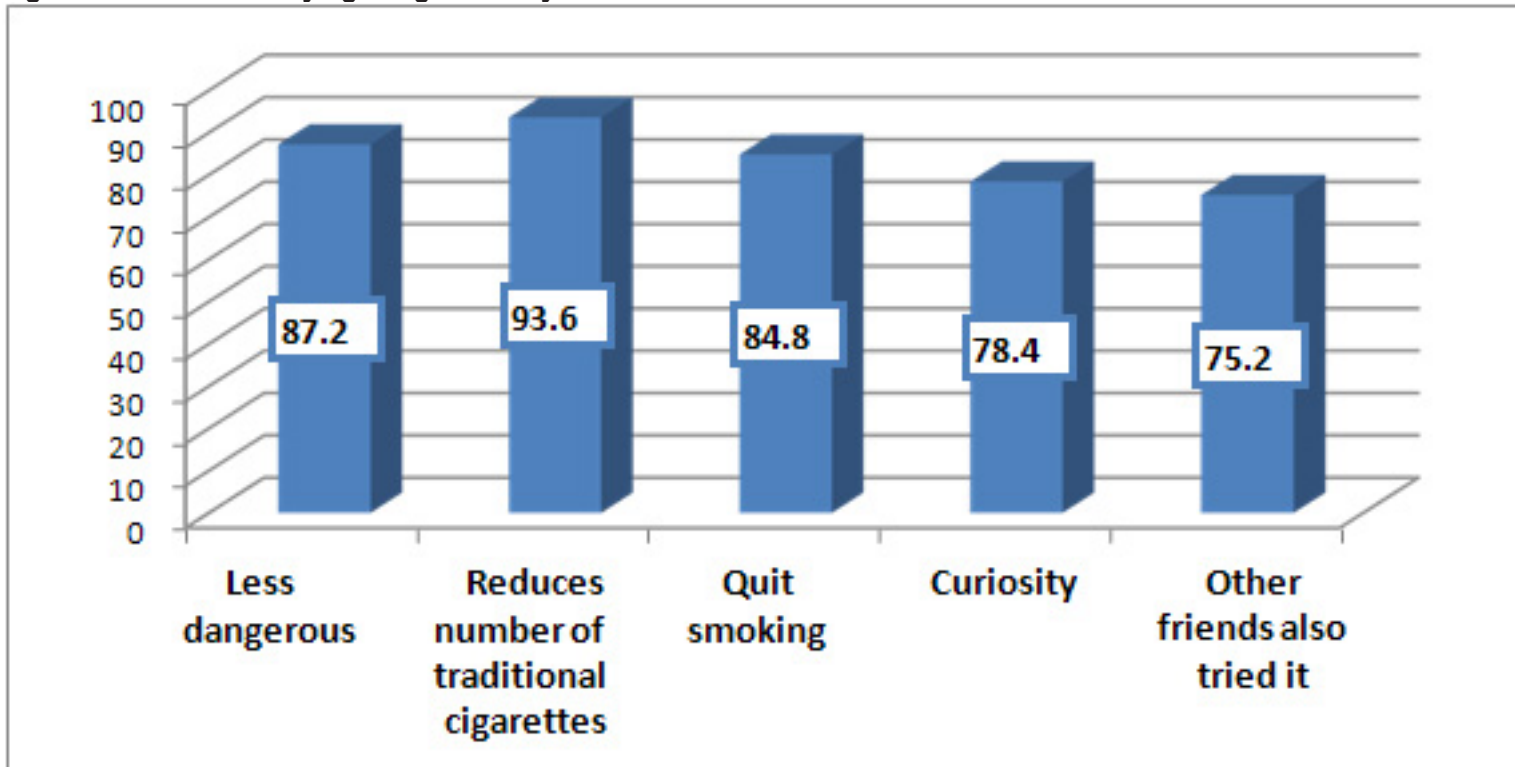
†Chi-square test

Table 13: Medical students' beliefs regarding E-cigarettes according to their seniority

Beliefs regarding E-cigarettes	Junior (n=128) No. (%)	Senior (n=212) No. (%)	P value†
E-cigarettes are less dangerous than traditional cigarettes	68 (53.1)	104 (49.1)	0.305
E-cigarettes can help smokers to quit	71 (55.5)	114 (53.8)	0.240
E-cigarettes are used only by smokers	35 (27.3)	54 (25.5)	0.479

†Chi-square test

Figure 1: Reasons for trying E-cigarettes by medical students



Discussion

The long-term adverse effects of E-cigarettes are not well known, since they contain dangerous chemicals like formaldehyde (12). Therefore, the effects of E-cigarettes on human health remain under frequent investigation (13).

Since the magnitude of the problem is not well documented in Saudi Arabia, the present study was conducted to estimate the prevalence and describe the pattern of E-cigarette smoking among medical students enrolled in King Khalid University students, Abha City, Saudi Arabia.

In the current study, most students have heard of E-cigarettes. Surprisingly, females have heard more than males about E-cigarettes. In the USA, males were more aware of E-cigarettes compared to females (16). Further studies are needed to explain this finding, especially when considering that female medical students in KGU also have tried E-cigarettes more than males. However, this finding is in agreement with that of another study carried out in the USA among the general population that reported a higher rate of females who tried E-cigarette smoking than males (17).

In the present study, almost one-third of the medical students have tried using E-cigarettes at least once during their lifetime, 15.9% have used them in the last month and 11.8% intended to use them in the next year.

Variable results were reported by different studies in Saudi Arabia. In another recent study carried out in Jeddah among students of the health science colleges, the prevalence of E-cigarette smoking was 27.7%; one-fifth of them were regularly using it. (7) Also, a rate of 25.6% has been reported by Awan among King Saud University's students in Riyadh (18). Moreover, an online survey reported that 33.5% of the general public in Saudi Arabia has tried E-cigarettes (19).

In Poland, the prevalence rates for E-cigarette smoking alone or combined with traditional cigarettes among medical students were 1.3% and 2.2%, respectively (20). Another study revealed a prevalence of E-cigarette smoking alone or both with traditional cigarettes at 1.1% and 1.8%, respectively among university students from five countries in Central and Eastern Europe (21). In a study carried out in Canada, trying E-cigarettes was admitted by 16.1% of young adults (16- 30 years) (22). Among USA individuals, only 8.1% had tried E-cigarettes, and the prevalence of current use was 1.4% (17). Another US study carried out among nursing, nutrition, and respiratory therapy students revealed that 21.2% had tried E-cigarettes at least once in their lifetime (16). In Romania, almost 25% of university students have tried e-cigarettes. (15).

This wide popularity of E-cigarettes in Saudi Arabia and other countries is probably attributed to the impact of advertising campaigns targeting adolescents and young adults, in a similar way that was applied to traditional cigarettes during the last century (23).

In the present study, there were no significant differences between students regarding the prevalence of E-cigarette use according to their current smoking status or their gender. However, alarmingly, junior students reported more trials of E-cigarette smoking than senior students. Also, students with parents or siblings who have tried E-cigarettes were more likely to try them compared to their peers.

In another study carried out in Poland, the overall prevalence of e-smoking was higher in males than females (4.9% versus 2.8%) (20). Also, in Central and Eastern Europe, the overall prevalence of E-cigarette smoking was higher in males than females (21). In Canada, the smoking status of young adults was important in determining E-cigarette smoking status as compared to non-smokers, ex-smokers and current smokers were more likely to have tried E-cigarettes, current smokers were more likely to have tried E-cigarettes than ex-smokers and current smokers were also more likely to be current users of E-cigarettes than both ex-smokers and non-smokers (22). In Romania, the predictors of E-cigarette smoking were male gender, being a current smoker of traditional cigarettes, having friends who have tried E-cigarettes, and having a belief that E-cigarettes could help in quitting smoking (15).

In the present study, among students who ever tried E-cigarettes, the commonest reported reasons were reducing the number of traditional cigarettes, believing that they are less dangerous than traditional cigarettes, and as an attempt to quit smoking.

In Saudi Arabia, in a study carried out in Jeddah, 42.7% of university students used E-cigarettes as a tool to quit smoking and 56.7% of them succeeded in quitting smoking (7). In Riyadh, almost one-quarter of university students use E-cigarettes to quit smoking (18).

A systematic review conducted to describe the pattern of use and attitude of the Saudi population toward E-cigarette smoking revealed that E-cigarettes smoking is high among Saudi nationals with different reasons for using, including reducing tobacco smoking, perceiving E-cigarettes as less harmful, less addictive, curiosity, lower cost, and peer influence (6).

In Poland, the main motivators to use E-cigarettes among medical students were quitting traditional tobacco, believing that they are less harmful to health and their cost (20). In Canada, the majority of smokers have tried E-cigarettes to help them quit smoking to be a long-term replacement for cigarettes or to smoke them where they cannot smoke (22). Contrary to that, Alanazi reported that the majority of nursing, nutrition, and respiratory therapy students in the USA disagreed that E-cigarettes are less dangerous than traditional cigarettes or can help smokers quit (16).

In the present study, there were no differences between smoker, ex-smoker, and non-smoker students regarding their beliefs regarding E-cigarettes. However, Brozek et al., in their multi-centric study among university students from five European countries observed a significant difference between smokers and non-smokers regarding perception of E-cigarettes (21).

Some limitations of the current study are acknowledged including the cross-sectional design and its inherited limitations for hypothesis generation and proving associations, rather than hypothesis testing or proving causality. Also, carrying out the study among medical students in one university is another limitation, which decreases the generalizability of our findings over the whole population. Moreover, the nature of data collection as being self-reported is subjected to recall and social desirability types of bias.

However, despite those limitations, the present study could identify why medical students, who are frequently considered role models, are using E-cigarettes. This could help decision makers to consider these reasons to put strategies to decrease the marketing strategies and consequently reduce the usage and sale of E-cigarettes.

In conclusion, E-cigarettes are being used by a considerable proportion of medical students at King Khalid University, Abha, particularly junior students, and those having parents and/or siblings who tried E-cigarette smoking. Female students are more aware of E-cigarettes and their contents and that they are not currently regulated by the Food and Drug Administration (FDA), than male students. On the other hand, male students are more aware than female students that E-cigarettes can be inhaled with different additives and flavors. Among students who ever tried E-cigarettes, the commonest reported reasons are to reduce the number of traditional cigarettes, assuming that E-cigarettes are less dangerous than traditional cigarettes, and as an attempt to quit smoking traditional cigarettes.

Therefore, it is necessary to raise awareness among adolescents and young adults about the possibly dangerous effects of E-cigarette smoking on their health and being as equally harmful as traditional cigarettes. Mass media and healthcare professionals should play an active role in increasing public awareness about the dangerous effects of E-cigarette smoking. The Ministry of Health should issue policies aiming at restricting the marketing and advertising of E-cigarettes as well as monitoring nicotine levels. Further study including on adolescents and young adults is necessary to have a clearer image of the situation in different regions of KSA.

References

1. WHO. Tobacco. World Health Organization. Available from: <http://www.who.int/mediacentre/factsheets/fs339/en/>. [cited 2021 Oct 5].
2. Centers for Disease Control and Prevention. Vital signs: current cigarette smoking among adults aged ≥ 18 years - United States, 2005-2010. *MMWR*. 2011;60(2):1207-12.
3. Al-Turki YA. Smoking habits among medical students in Central Saudi Arabia. *Saudi Med J*. 2006;27(5):700-3.
4. Al-Ghaneem SG, Al-Nefisah OS. The prevalence of smoking among male students of Majmaah University, KSA. *Journal of Taibah University Medical Sciences* 2016;11(2):175-178.
5. Azhar A, Alsayed N. Prevalence of smoking among female medical students in Saudi Arabia. *Asian Pac J Cancer Prev*. 2012; 13(9):4245-8.
6. Khanagar SB, Siddeeqh S, Khinda V, Khinda P, Divakar DD, Jhugroo C. Impact of electronic cigarette smoking on the Saudi population through the analysis of literature: A systematic review. *J Oral Maxillofac Pathol* 2019; 23:473.
7. Qanash S, Alemam S, Mahdi E, Softah J, Touman AA, Alsulami A. Electronic cigarette among health science students in Saudi Arabia. *Ann Thorac Med* 2019; 14:56-62.
8. Vaporizers, E-Cigarettes, and other Electronic Nicotine Delivery Systems (ENDS). FDA.gov; 2017. Available from: <https://www.fda.gov/tobacco-products/labeling/product-ingredients/components/ucm456610.htm>. [Last accessed on 2021 Apr 06].
9. Kong G, Morean ME, Cavallo DA, Camenga DR, Krishnan-Sarin S. Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. *Nicotine Tob Res* 2015; 17:847-54.
10. Krishnan-Sarin S, Morean ME, Camenga DR, Cavallo DA, Kong G. E-cigarette use among high school and middle school adolescents in Connecticut. *Nicotine Tob Res* 2015; 17:810-8.
11. Ferkol TW, Farber HJ, La Grutta S, Leone FT, Marshall HM, Neptune E, et al. Electronic-cigarette use in youths: A position statement of the forum of international respiratory societies. *Eur Respir J* 2018; 51. pii: 1800278.
12. Jensen RP, Luo W, Pankow JF, Strongin RM, Peyton DH. Hidden formaldehyde in e-cigarette aerosols. *N Engl J Med* 2015; 372:392-4.
13. Callahan-Lyon P. Electronic cigarettes: Human health effects. *Tob Control* 2014;23 Suppl 2:ii36-40.
14. Dahiru T, Aliyu A, Kene TS. Statistics in Medical Research: Misuse of Sampling and Sample Size Determination. *Annals of African Medicine* 2006; 5(3):158-61.
15. Lotrean LM. Use of electronic cigarettes among Romanian university students: a cross-sectional study. *BMC Public Health* 2015; 15:358 DOI 10.1186/s12889-015-1713-6
16. Alanazi AM. The prevalence of use, awareness and beliefs of electronic cigarettes among college-based health care students at a Southeastern Urban University. A thesis submitted in partial fulfillment of requirements for the degree of Masters of Science in Health Sciences in The Department of Respiratory Therapy Georgia State University, Atlanta, Georgia, 2016
17. Zhu S-H, Gamst A, Lee M, Cummins S, Yin L, Zoref L. The use and perception of electronic cigarettes and snus among the U.S. population. *PLoS ONE* 2013;8(10): e79332. doi: 10.1371/journal.pone.0079332
18. Awan KH. Experimentation and correlates of electronic nicotine delivery system (electronic cigarettes) among university students - A cross sectional study. *Saudi Dent J*. 2016; 28:91-5.
19. Al Baik M, Abdrabulnabi A, Aldahan S, Alkhadhrawi N. Electronic cigarette in Saudi Arabia: An online survey. *Valley Int J*. 2014; 1:411-26.

20. Brożek G, Jankowski M, Zejda J, Jarosińska A, Idzik A, Bańka P. E-smoking among students of medicine — frequency, pattern and motivations. *Adv Respir Med* 2017; 85: 8–1 DOI: 10.5603/ARM. 2017.0003.
21. Brozek GM, Jankowski M, Lawson JA, Shpakou A, Poznański M, Zielonka TM, et al. The prevalence of cigarette and e-cigarette smoking among students in Central and Eastern Europe—Results of the YUPESS Study. *Int. J. Environ. Res. Public Health* 2019, 16, 2297; doi:10.3390/ijerph16132297.
22. Czoli CD, Hammond D, White CM. Electronic cigarettes in Canada: Prevalence of use and perceptions among youth and young adults. *Can J Public Health* 2014; 105(2):e97-e102.
23. Gravely S, Fong GT, Cummings KM, Yan M, Quah ACK, Borland R. et al. Awareness, trial, and current use of electronic cigarettes in 10 countries: findings from the ITC project. *Int J Environ Res Public Health* 2014; 11: 11691–11704.