

# Prevalence and perceptions of e-cigarette use among medical students in a Saudi University

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## ABSTRACT

**Background and Aims:** We hypothesized that the prevalence of electronic cigarette vaping among the medical student population is on the rise. Our aims were to assess the prevalence of electronic cigarette vaping among medical students in Saudi Arabia, to understand and analyze the reasons that led them to try it, and to investigate students' perceptions towards electronic cigarette vaping. **Methods:** An anonymous, paper-based, cross-sectional questionnaire was distributed amongst 401 undergraduate medical students from years 1-5 at Alfaisal University in Riyadh, Saudi Arabia. Prevalence, intensity of e-cigarette use and reasons for it, relation of electronic cigarettes to cessation of tobacco smoking, and side effects were studied. **Results:** The prevalence of vaping was 49/401 (12.2%). There was a strong association between gender and vaping, with males being 3 times more likely to vape compared to females ( $\chi^2(1) = 13.62, P < .001$ ). The three most common reasons for using electronic cigarettes were to enjoy the variability in flavours (61.4%,  $n = 30$ ), to reduce or quit tobacco cigarettes (29.5%,  $n = 14$ ), and to avert the public smoking ban (13.6%,  $n = 7$ ). The three most common side effects experienced by users were coughing (26.7%,  $n = 13$ ), dry mouth/throat (24.4%,  $n = 12$ ), and dizziness (20%,  $n = 10$ ). **Conclusion:** Use of the electronic cigarettes is not uncommon amongst medical students, mostly due to their appealing flavor variability. Further research is required to define long-term safety and side effect profiles, and to generate evidence-based guidelines concerning e-cigarette safety and efficacy for smoking cessation.

**Keywords:** Electronic cigarette, medical student, prevalence, Saudi Arabia, vaping

## Introduction

The electronic cigarette (e-cigarette) is typically a battery-operated product designed to deliver nicotine, flavor (which can be picked by the user) and other chemicals including propylene glycol and/or glycerol.

This mixture is inhaled from the cartridge and released in the form of a vapor, in contrast to a cigarette that burns tobacco and releases smoke. E-cigarettes (also known as vape pens or

vaporizers) are second, third, or fourth generation electronic nicotine delivery systems (ENDS) that are designed for nicotine delivery, but have less resemblance to real cigarettes than first generation delivery systems ("cigalikes").<sup>[1]</sup>

Released in 2004, this novel device was found to be particularly appealing to young adults due to its claims about safety and the potential for smoking cessation, as well as its hand-to-mouth action and delivery of nicotine.<sup>[2]</sup> E-cigarettes are able to give a similar sensation to smoking a cigarette through means of delivering taste and inhaling sensations.<sup>[3]</sup>

E-cigarettes are becoming more popular among adolescents and young adults globally.<sup>[4]</sup> The prevalence of e-cigarette use among

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young adults (ages 16-30) has been studied in several international regions, including the USA, Canada, Europe and New Zealand.<sup>[2,5]</sup> Data from these regions showed that e-cigarette use increased rapidly over the past few years, reaching as high as 14.7% of ever-users among US medical students.<sup>[6]</sup>

Reports published in *New England Journal of Medicine* demonstrated a 10% increase in adolescents' use of e-cigarettes from 2017-2018, which corresponded to 1.3 million teenagers,<sup>[7]</sup> as well as a continuing increase from 2018-2019.<sup>[8]</sup> Yet despite its popularity, there are no current regulations that monitor the composition and effects of e-cigarettes on the population.

Since their introduction, many alterations have been made to the vaping products which led to the rise of an ongoing epidemic. In March 2019, the use of e-cigarettes was linked to the development of acute lung injury.<sup>[9]</sup> Over 2600 cases were reported. The term EVALI (e-cigarette or vaping-product associated lung injury) was established, which prompted further research into the use of e-cigarettes.<sup>[9]</sup> Not only was it linked to acute lung injury, other studies found an impairment in memory and executive function among adolescents. One study concluded that both the nicotine and non-nicotine components of e-cigarettes led to increased aggressiveness, impulsiveness, attention deficits, and suicidal ideation among its young users.<sup>[10]</sup>

However, to our knowledge, there has been very scarce data concerning the Middle East region, particularly Saudi Arabia. Furthermore, there is currently very little data about the prevalence, patterns, reasons or side effects of e-cigarettes in the medical student population anywhere in the world. It is of particular importance to study the perceptions of these future doctors, who should ideally be health advocates for patients and the general public in the future, about the use and effects of these devices, as well as assessing how effective they were in cessation of smoking and whether there were any perceived health benefits.

The latest published report regarding the prevalence of tobacco smoking in Saudi Arabia comes from a national survey done in 2013, which reported a prevalence of 12.2% among the Saudi population.<sup>[11]</sup> A further breakdown showed that males were more likely to smoke compared to females (21.5% vs 1.1%, respectively). Another meta-analysis of tobacco smoking prevalence among college students in Saudi Arabia was recently published and reported that the pooled estimate of smoking prevalence was 17%.<sup>[12]</sup> This report also stated that males (prevalence rate of 26%) were much more likely to smoke compared to females (prevalence rate of 5%).

These numbers indicate that trends regarding vaping are worth exploring in the Saudi population, who may start vaping to reduce or even quit smoking. A meta-analysis showed that e-cigarettes aid conventional cigarette smokers to quit smoking as compared to a placebo.<sup>[13]</sup> Another study showed that there was a strong association between conventional smoking and e-cigarette use among both adolescents and adults.<sup>[14]</sup> It is worth noting that

the sale of all e-cigarette or vaping products has been officially banned in Saudi Arabia since September, 2015. However, personal consumption of e-cigarettes is permitted for those who are over 18 years old.<sup>[15]</sup>

A study done in Jeddah 2017 involving three different universities with a total of 1007 participants concluded that 27.7% of the students used e-cigarettes.<sup>[16]</sup> Among the e-cigarette users, only 42.7% used it as a method to quit smoking. Another study published addressed the prevalence of vaping among the Saudi medical student population,<sup>[17]</sup> concluding that 10.6% of students have tried e-cigarettes at some point. The aim of this study were to assess the prevalence of e-cigarette use among medical students in Saudi Arabia, to investigate the students' perceptions towards electronic cigarettes, and to understand and analyze the reasons that lead students to try an e-cigarette.

## Methods

### Study design and participants

Institutional Review Board (IRB) approval was obtained from the IRB Board at Alfaisal University in Riyadh, KSA. This approval granted us with the ethical clearance to conduct the study. A paper-based questionnaire was distributed among 401 undergraduate medical students across years 1 to 5 at Alfaisal University. The conducted cross-sectional study was voluntary and completed anonymously. It assessed the prevalence and intensity of e-cigarettes, reasons for use, as well as the relation of electronic cigarettes to reduction or cessation of tobacco smoking, and lastly the symptoms and side effects associated with e-cigarette use.

### Data collection method

#### Demographics

Students indicated their gender, academic year, and age.

Survey items were developed based on previous surveys of medical students regarding e-cigarettes in University of Minnesota,<sup>[14]</sup> a university in Spain<sup>[18]</sup> as well as a questionnaire given to New Zealand adults.<sup>[2]</sup>

### Survey questions

The entire survey was written in English. Students were initially asked if they have at any point previously used electronic cigarettes, and whether they had a history of smoking tobacco cigarettes. If students answered "Yes" to smoking tobacco, they were asked whether they have quit or are still smoking. Patterns of electronic vaping and tobacco cigarette smoking by the participants were assessed. This included the duration, frequency of use, reasons towards vaping and side effects experienced, if any. Students were provided with reasons to pick from, and could choose as many reasons as possible that applied to them as well as provide their own. The reasons we provided were as follow: I want to reduce/quit smoking as it is not a healthy habit,

I enjoy the variability in flavors, to reduce smoking exposure to family members and people around me, to avoid the smoking ban in public places, and lastly, electronic cigarettes are cheaper than tobacco cigarettes. Cartridge use duration was also inquired about, with a cartridge defined as a 60 mL bottle containing 3 mg of nicotine. Students were asked whether they believe that, compared to tobacco smoke, electronic cigarettes were less, equal or more harmful. Any underlying medical conditions were also noted. Lastly, students were asked whether electronic cigarettes are an effective method of quitting smoking through a linear scale from 1-5, 1 being ‘strongly disagree’, and 5 being ‘strongly agree’.

**Statistical analysis**

Descriptive statistical analysis was carried out. Categorical data were presented as numbers and percentages. A Chi-square test was used to compare the categorical variables. Statistical significance was determined as  $P < 0.05$  for all purposes. All data were analyzed using the Statistical Package for Social Sciences version 24.0.

**Results**

Out of 521 students, a total of 401 responses were obtained, yielding a response rate of 77%. Demographics of participants are shown in Table 1. 157 respondents were male (39%) while 244 were female (61%). Ages ranged from 18-23 while the mean age was 20 years, with a standard deviation of 1.4. The overall prevalence of vaping (ever-use) was 49/401 (12.2%). The rate of current use was 7.2% (29). There was a strong association between gender and whether they had tried to vape or not,  $\chi^2 (1) = 13.62, P < .001$ . Proportionately more men than women vaped, 19.7% vs 7.4% respectively. In addition, there was a statistical association between age and vape,  $\chi^2 (5) = 21.3, P = 0.001$ , with those aged 22 being the most likely to vape, as shown in Table 2.

The percentage of students who tried vaping and had a history of smoking tobacco cigarettes was 43% (n = 21). However, the raw number (21) amounts to 5.2% of the whole population that was surveyed. Of these 21 students with a smoking history, 47.6% (n = 10) said they quit, and 52.4% (n = 11) continue to smoke, making the total percentage of vape ever-users who are current tobacco smokers 22.4%.

Table 3 depicts the results about participants’ opinions on whether vaping is an effective method of quitting smoking. 8.2% (n = 4) and 12.2% (n = 6) strongly disagreed or disagreed respectively, whereas 20.4% (n = 10) and 26.5% (n = 13) strongly agreed or agreed respectively. 22.4% (n = 11) neither agreed nor disagreed with this statement. 10.2% (n = 5) students did not answer this question. In terms of frequency of vaping, 32.7% (n = 16) said that they no longer vape, 38.8% (n = 19) said they vaped occasionally (equal or less than 3 times per week), 20.4% (n = 10) vape daily. 8.2% (n = 4) of the 49 respondents did not provide us with an answer to this question.

**Table 1: Demographic data of participants**

Demographic data of participants	
Variable	n=401 (%)
Gender	
Male	157 (39)
Female	244 (61)
Academic Year	
First Year	92 (23)
Second Year	87 (22)
Third Year	81 (20)
Fourth Year	69 (17)
Fifth Year	72 (18)
Age, mean (SD)	20 (1.4)
E-cigarette Use	
Ever-use	49 (12.2)
Current use	29 (7.2)

**Table 2: Participants’ responses to the question: “Do you, or have you at any point previously, used electronic cigarettes (vape)?” divided by age**

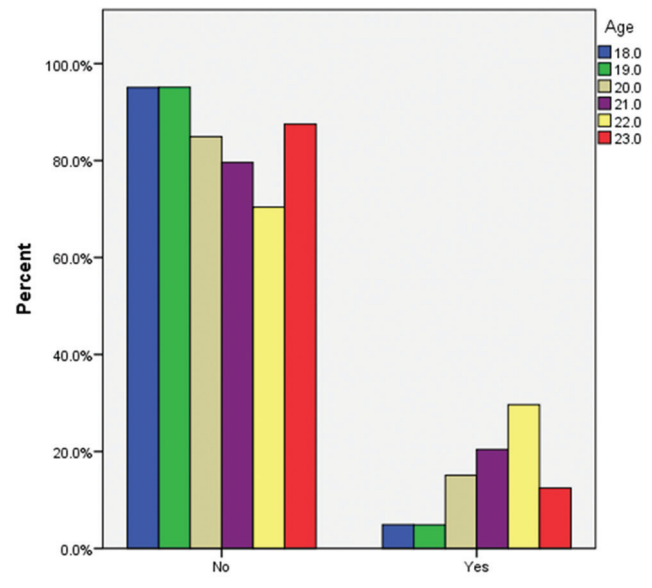
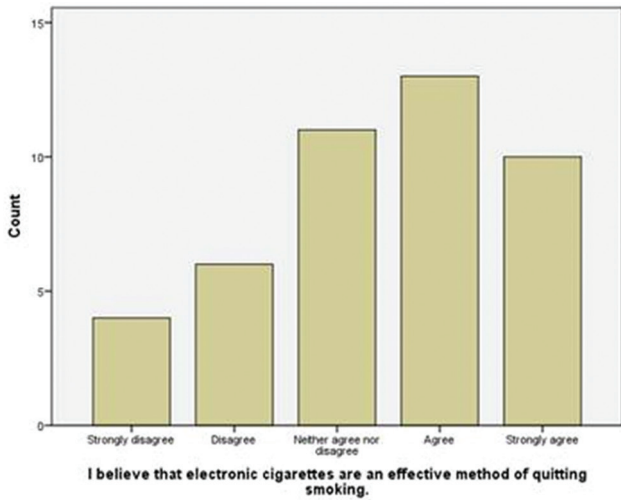


Table 4 summarizes the extent of vaping in terms of cartridge usage duration. Of the 49 students who vape, 30.6% (n = 15) use up a cartridge in less than 2 weeks. 20.4% (n = 10) use one cartridge over 2-4 weeks, 18.4% (n = 9) over 4-6 weeks, 4.1% (n = 2) over 6-8 weeks, and 14.3% (n = 7) over more than 2 months per cartridge. 12.2% (n = 6) did not provide us with an answer to this question.

Students reported a number of different reasons for using electronic cigarettes, as shown in Table 5. Of the 49 who vape, 29.5% are doing it to reduce or quit tobacco. 11.4% of students have switched over to reduce smoking exposures to family members and people around them, 13.6% to avoid the public smoking ban, 61.4% of students enjoy the variability in flavors of electronic cigarettes, and 6.8% cite the fact that electronic cigarettes are cheaper than tobacco cigarettes.

**Table 3: Participant answers in response to the statement: “I believe that electronic cigarettes are an effective method of quitting smoking.”, N = 44**



**Table 4: Participant answers in response to the question: “On average, how long does one cartridge (defined as a 60 mL bottle with 3 mg of nicotine) last with you?”, n=43**

Participant Answer	Frequency	Percent	
Valid	0-2 weeks	15	30.6
	2-4 weeks	10	20.4
	4-6 weeks	9	18.4
	6-8 weeks	2	4.1
	More than 8 weeks	7	14.3
Missing	6	12.2	
Total	49	100.0	

**Table 5: Participants’ reasons for using e-cigarettes**

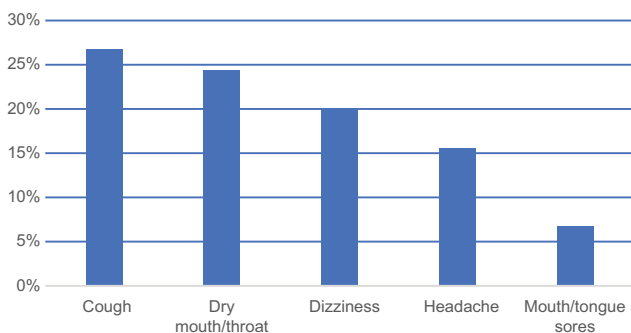


Table 6 shows participant responses on their opinion towards the harmfulness of tobacco smoking compared to electronic cigarettes. 6.1% (n = 3) believe that vaping is absolutely harmless, 69.4% (n = 34) believe that it is less harmful than tobacco smoking, 8.2% (n = 4) believe that they are equally as harmful, and another 8.2% (n = 4) believe that vaping is in fact more harmful than tobacco smoking. 8.2% (n = 4) of students did not answer this question.

A variety of negative side effects of electronic cigarettes were reported by students, summarized in Table 7. The 3 most common side effects were coughing (26.7%), dry mouth/throat (24.4%), and dizziness (20%). Other side effects included headaches (15.6%), mouth/tongue sores (6.7%), sleeplessness (11.1%) and heart palpitations (8.9%). 8.2% of participants reported an increase in side effect frequency over time.

## Discussion

In this study, we assessed the prevalence of electronic cigarette smoking among medical students and whether it proved to be of any use in quitting conventional smoking. In our study, ever-use of e-cigarettes was 12.2%. This figure is similar to that reported from another study done on medical students at Qassim University, also in Saudi Arabia, who reported a 10.6% rate of ever-use.<sup>[17]</sup> Our prevalence is also similar to a study done at the medical school of the University of Minnesota which reported a prevalence of 14.7%.<sup>[6]</sup> Despite this, the rate of current use in our study was 7.2%, higher than either of the studies reported above.

22% of e-cigarette ever-users in our medical college are active tobacco smokers. This value is very close to a study done in France on college students,<sup>[19]</sup> which reported a figure of 23%. However, there is currently no data regarding this number among medical students anywhere else.

Our study showed that male students are more likely to vape compared to females. This trend was also observed in the study done at the University of Minnesota.<sup>[6]</sup> However, they mentioned that there was a significant overlap and “potential for confounding”. We hypothesize that males were more likely to vape due to the cultural implications of smoking in Saudi Arabia, which is supported by the rates of male smokers (21.5%) compared to female smokers (1.1%) in the country<sup>[11]</sup> as well as 26% of male college students compared to 5% of female students.<sup>[12]</sup> Worldwide, prior surveys done showed mixed results with some studies reporting a higher prevalence of e-cigarette ever-use in males,<sup>[20,21]</sup> others in females,<sup>[22]</sup> while others reported no significant difference based solely on gender.<sup>[1,2,23,24]</sup> Thus, it is unlikely that there is a certain universal trend linking gender to e-cigarette use. However, none of these studies were specifically targeting medical students. Another trend worth taking note of is the age distribution of e-cigarette users. It is widely acknowledged in the literature that young adults aged 18-25 are more likely to smoke compared to other age groups.<sup>[24,25]</sup> In our study, the standardized residuals tell us that more 22 year olds vape than expected, while fewer 19 year olds vape than expected, i.e. users are more likely to be senior university students.

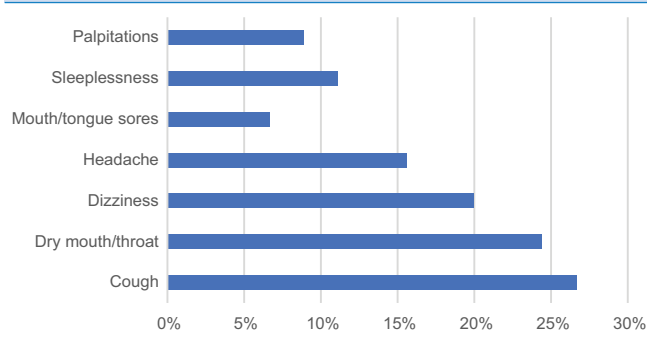
E-cigarettes are able to give a similar sensation to smoking a cigarette through means of delivering taste and inhaling sensations which, when compared to those provided by a nicotine inhalator, are closer and more superior.<sup>[13]</sup> However, since 28 (57%) of e-cigarette users had not been tobacco smokers, this



**Table 6: Participant answers in response to the question: “In your opinion, compared to tobacco smoke, electronic cigarettes are:”, n=45**

Participant Answer	Frequency	Percent
Valid		
Absolutely harmless	3	6.1
Less harmful than tobacco cigarettes	34	69.4
Equally harmful as tobacco cigarettes	4	8.2
More harmful than tobacco cigarettes	4	8.2
Missing	4	8.2
Total	49	100.0

**Table 7: Summary of side effects experienced by participants**



suggests that e-cigarettes are not perceived purely as an aid for tobacco smoke cessation. In terms of the reasons that pushed students to trying out e-cigarettes, many users (30) attributed their start of use to sheer curiosity and desire to try out the different flavors. This finding is also the most commonly reported in New Zealand,<sup>[2]</sup> in contrast to the main reason in a US study which was “just because”.<sup>[25]</sup> However, it is worth noting that the latter study did not have “curiosity” as one of their options in the survey. In the study done in UK by Dockrell,<sup>[24]</sup> they reported the most common reason as a substitute to smoking (43%), which was our second most common reason (29.5%).

There was no clear consensus on whether students believe vaping is an effective method of quitting smoking. This finding is consistent with data from medical students at Qassim University<sup>[17]</sup> as well as the University of Minnesota.<sup>[6]</sup> This suggests that medical students are in dire need for education about vaping patterns in relation to quitting tobacco smoking, because the fact remains that the FDA did not approve these devices for smoking cessation. As prevalence of e-cigarette use continues to rise, it is imperative to ensure these future doctors are provided with a sufficient breadth of knowledge that they can use to answer their patients’ concerns in the future.

Regarding the students’ perception of the harm conferred through the use of “vapes”, 69.4% of students believe that it carries a much lessened risk of developing any serious side effects

compared to tobacco smoke. Any side effects that were reported were simply accounted for by the heavy dosing of nicotine, and only 8.2% reported an increase in side effect frequency.

Another aspect of vape use in our study was the frequency of use, as measured by how long a cartridge lasts on average. There was almost equal distribution among all answer items, indicating that frequency of use is variable depending on personal choice. Another study which reported data from the National Epidemiologic Survey on Alcohol and Related Conditions also did not find a significant difference in the number of cartridges consumed by different users over a year.<sup>[26]</sup>

In the practice of primary care, smoking cessation advice is routinely embedded. Therefore, it is pivotal for primary care physicians to be well aware of the available smoking methods as well as strategies patients may explore in order to quit smoking. A study published in 2016 concluded that primary care physicians expressed a lack of knowledge about e-cigarette efficacy and safety.<sup>[27]</sup> In addition, physicians were unsure about the role of e-cigarettes in smoking cessation. More studies regarding these concerning perceptions are lacking in the literature, but these findings only serve to illustrate the significance of producing and rapidly disseminating evidence-based guidelines concerning e-cigarette safety and efficacy for smoking cessation. A lack of such efforts will only mean that primary care physicians will continue to devise their personal beliefs, translate them into practices, and solidify these practices once established.

Limitations of this study include that our survey was a self-report tool, so the accuracy of the information entered cannot be verified. In addition, the study was based in a single institution so the results cannot be generalized to the entire medical student population or even those in Saudi Arabia solely.

## Conclusions

Usage of electronic cigarettes is not uncommon amongst medical students. Many students who vape did not previously smoke, and only a small percentage of them reported that e-cigarettes aid in smoking cessation. The majority of vape users indicated that they simply use vape due to its appealing flavor variability. Vape is not completely chemical-free, and it has been linked to serious healthcare outcomes including acute lung injury. Yet, despite its potential side effects, there is a lack of education among medical students and the general population about the potential consequences of using e-cigarettes. Nonetheless, further research is required to generate appropriate evidence on the long-term safety, side effect profile, and the exact ingredients incorporated into the vape cartridges to ensure the well-being of its consumers. This data should translate into evidence-based guidelines concerning e-cigarette safety and efficacy for smoking cessation, which will then be rapidly disseminated to primary care physicians who are in dire need to be updated about this rising epidemic.

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## Conflicts of interest

There are no conflicts of interest.

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