Research Report

Impact of VAPE use on dental and oral health among male dental students

Mohammed Hassan Khalaf[1], Maryam Hameed Alwan[1]
[1]Department of Oral Diagnostic Sciences, College of Dentistry, Baghdad University, Iraq

ABSTRACT

Background: The emergence of vaping as a popular alternative to traditional smoking has raised concerns regarding its potential impact on oral health. specifically affects the oral health of dental students, who are not only consumers of these products but also future practitioners tasked with educating patients on oral hygiene and health risks. **Purpose:** This study investigated the dental and oral health impact of VAPE among male dental students. **Methods:** A self-administered questionnaire comprising 20 questions was meticulously designed to gather relevant data about their VAPE use and its implications on dental and oral health. **Results:** 43% of participants reported using VAPE, predominantly employing salt nicotine (48.8%) over free base nicotine (27.9%). The dental health statuses, assessed using the Decayed, Missing, and Filled Teeth (DMFT) index, showed that 35.6% had a DMFT score of 3 or higher, while 37.6% had scores below 3, and 26.7% reported a DMFT of 0. Most participants (57.4%) visited the dentist rarely, with no distinction between VAPE users and non-users. However, significant differences in aspects such as breathing, sleep quality, and fitness were noted between VAPE users and non-users (p:0.002, p:0.05, and p:0.00; p<0.05), respectively. **Conclusion:** As E-cigarettes smoking is becoming more widely growing habit within the young age group, more oral and physiological consequences begin to rise, such as a significantly higher prevalence of mouth dryness, cough and ultimately, worsened bodily functions including a lower breathing quality and reduced level of fitness.

Keywords: Oral Health; Electronic Cigarettes (E-Cigs); Vaping; Smoking; Medicine

Correspondence: Maryam Hameed Alwan, Department of Oral Diagnostic Sciences, College of Dentistry, Baghdad University, Iraq.
E-mail: maryam.h@codental.uobaghdad.edu.iq

INTRODUCTION

E-cigarettes are battery powered devices that utilize a heating element to vaporize a commercially available flavored solution that usually contains nicotine. The rapid vaporization of the solution leads to the creation of an aerosol to be inhaled by the user to gain the effect of nicotine. The heated solution typically contains propylene glycol or glycerin, water, nicotine, and flavorings. E-cigarettes do not contain tobacco, do not create smoke and do not rely on combustion.[1]

Since 2015, there has been a significant shift in the design of e-cigarette devices with regard to the efficiency of nicotine delivery. The pod, a smaller and lighter device, was introduced, making it more convenient for the user. Propylene glycol (PG) and/or vegetable glycerin (VG), nicotine and/or other pharmacological compounds, and food-grade flavoring seem to be the main ingredients of E-cigarettes solutions, also known as e-liquids, despite the fact that their composition varies widely amongst commercial vendors.[2]

Since e-liquids come in over 8000 varieties that are designed to suit every taste, flavoring plays a significant part in the allure of forming a habit for users. Young people are especially interested in sweet flavors, but consumers generally prefer tobacco, menthol, and fruit flavors. Most e-liquids contain multiple flavoring chemical compounds, with an average of six; sweet flavors typically contain more compounds (i.e., saccharides) than tobacco and menthol flavors.[3,4]

The majority of flavoring ingredients in e-liquids are categorized as GRAS (generally recognized as safe) for oral consumption; however, their safety profile when inhaled has not yet been determined, and some of them are actually harmful. For instance, sweeteners like saccharides thermally break down into furans and aldehydes. Cinnamaldehyde is another frequent flavoring ingredient that has been shown to be cytotoxic and to exhibit dose-dependent cytotoxicity.[5]

Clinical evidence for oral health consequences of E-cigarettes use remains limited because of the lack of clinical trials, however; there has been an increasing number of studies exploring the oral effect of the yet newly adopted trend of E-cigarettes use. Similar to conventional cigarettes, E-cigarettes can also have negative effects on oral health. The mouth, being the initial area of the body that comes into contact with the ingredients in E-cigarettes

and other tobacco products, faces a heightened risk of harmful exposure to substances that can lead to cancer, immune issues, and other microbial and clinical problems. Additionally, the thick consistency of E-liquid fosters the growth of Streptococcus mutans, which is a key contributor to tooth decay.[6]

For instance, one common issue that arises is dry mouth, or xerostomia, which can occur due to the ingredients in E-cigarettes that reduce saliva production. This not only leads to discomfort but can also create an environment in the mouth favorable for bacterial growth, increasing the risk of gum disease.[7,8] According to certain microbiological research, E-cigarettes users have a unique microbiological environment, which may be more harmful than that of non-users. These effects seemed to be caused by e-liquid ingredients other than nicotine, most likely glycerol or polyethylene glycol.[9] Another possibility is that E-cigarettes indirectly alter the oral microbiota. In fact, it has been demonstrated that they impact the amounts of cytokines and antimicrobial proteins in saliva.[10] Furthermore, the inhalation of vapor can irritate gum tissues, making them more susceptible to inflammation and infection. According to WHO, exposure to vapour has the potential to be harmful, as a new air contamination source for particulate matter.[11]

Many studies have examined health behaviors across various student populations, but the specific challenges and pressures faced by dental students deserve more attention. By investigating these factors, we can better understand their oral health needs and ultimately enhance both their well-being and the care they will offer as future professionals. Furthermore, this study aim to investigated the dental and oral health impact of VAPE among male dental students.

MATERIALS AND METHODS

The cross-sectional survey study was carried out in compliance with Baghdad University College of Dentistry's experimental ethical guidelines. All respondents participated voluntarily, and the principles established in the Helsinki Declaration have been followed in this research.[12] An online survey was distributed to students at the University of Baghdad College of Dentistry via email invitations. The survey link was also shared on the student groups to reach a wider audience. The recruitment process involved reaching out to the students and providing them with detailed information regarding the study's objectives and procedures. Participation was entirely voluntary, ensuring that students could opt in or out without any repercussions on their current or future academic standing. Prior to participation, all subjects were thoroughly informed about the study's aims and the measures taken to ensure data confidentiality. Participants were assured that their responses would be used solely for research purposes and that their personal information would be kept private. This commitment to privacy was emphasized to encourage participation and foster an environment of trust.

The study sample consisted of male undergraduate dental students from the 3rd, 4th, and 5th stages of their education. A self-administered questionnaire comprising 20 questions was meticulously designed to gather relevant data about their VAPE use and its implications on dental and oral health. This online questionnaire was distributed over a designated period from December 2023 to January 2024, allowing participants the flexibility to complete it at their convenience while contributing valuable insights into the research focus. Careful attention was given to ensure clarity and ease of understanding in the questionnaire to maximize valid responses and engagement from the participants.

The replies were validated, coded, and imported from Excel sheet to statistical package for social science (SPSS; IBM corporation, Illinois, US) version 26. The study variables were described using descriptive statistics such as frequencies and percentages. The potential correlations between the outcome and explanatory factors were evaluated using the Chi-square test, with a P-value of less than 0.5 indicating statistical significance.

The questionnaires depended on three assessments: First, E-cigarette use assessment. Second, oral health and oral hygiene practices assessment. Third, self-perceived symptoms and changes in physiological functions.

E-cigarettes use: This part included three questions regarding the use of E-cigarettes, these questions evaluate whether or not the subject uses E-cigarettes, the concentration and type of nicotine used in the e-liquid if the subject is a user, these questions are listed in Table 1.

Table 1. E-cigarettes use assessment

Questions	Options
Do you use E-cigarettes?	Yes, I do No, I don't
What concentration of nicotine do you use?	3mg or 0.3% 6mg or 0.6% 12mg or 1.2% 20mg or 2% 30mg or 3% 50mg or 5% I don't know I don't use
What type of nicotine compound do you use?	Freebase nicotine Nicotine salts I don't know I don't use

Table 2. Oral health and oral hygiene practices assessment

Questions	Options
What the number of your decayed, missing or filled teeth?	None Less than three Three or more
How many times do you brush your teeth?	I don't brush Once daily Twice or more daily
Do you use a fluoride containing toothpaste?	Yes No I don't know
Do you consume sweets or sweetened soft drinks?	On a daily basis Weekly Rarely
Do you use oral hygiene products?(other than a brush and a toothpaste)	Yes No
How often do you visit the dental office?	More than twice yearly Once or twice per year Rarely

Oral health and oral hygiene practices: This part included an assessment of the subject's self-applied oral health and hygiene measures consisting of six questions evaluating DMFT, type and frequency of oral hygiene products, consumption of sugary food and drinks, and frequency of visits to the dental office, these questions are listed in Table 2.

Self-perceived symptoms and changes in physiological functions: This part in turn is composed of two assessments, the first one consisting of a checklist of self-perceived, systemic and oral symptoms within the past month and they subject can select multiple choices of the listed symptoms Table 3. The second one assesses the subject's self-perceived changes in overall physiologic functions within the past month and consisting of nine questions (Table 4).

RESULTS

A 43 % of male dental students use VAPE smoking. The majority of VAPE smokers use salt nicotine 48.8 %, while 27.9 % free base type nicotine. The reported DMFT and oral hygiene practices are presented in Table 5. To some extent more than 1/3 of the sample (35.6%) having DMFT ≥ 3, 37.6% having DMFT < 3, and 26.7% having DMFT = 0, with no statistically significant differences according to the students' smoking status.

More than ½ of the students reported brushing their teeth 2 times or more daily (55.4%) and using fluoride-containing toothpaste (71.3%), with significant differences according to their smoking status ($P = 0.003$ each). Almost 90% of the applicants reported that they eat sweets or drink sugary soft drinks on a daily (41.6%) or weekly basis (41.6%), and up to 47.5% of the participants reported that they use their oral-care devices, but with [no significant differences] according to the smoking status ($P = 0.57$ and $P = 0.166$, respectively). Most participants (57.4%) reported rarely visiting the dentist, with no significant difference between E-cigarette users and other groups (Table 5).

Table 6 displays the respondents' subjective complaints. Perceived health issues linked to smoking varied in frequency, with as little as 1% reporting chest pain and as many as 18% reporting dry mouth. against those who do not smoke. The t-test was highly significant ($P < 0.001$).

Table 3. Self-perceived symptoms assessment

Question	Options
Did you notice any of these symptoms within the past month?	Sore mouth and/or throat
	Dry mouth and/or throat
	Mouth and/or tongue inflammation
	Black tongue
	Gingivitis
	Nose bleeding
	Headache
	Cough
	Chest pain
	Dizziness
	Heart palpitation
	Allergy

Table 4. Self-perceived changes in physiological functions assessment

Questions	Options
Physical status	Worsened
	No change
	Improved
Smell	Worsened
	No change
	Improved
Taste	Worsened
	No change
	Improved
Breathing	Worsened
	No change
	Improved
Appetite	Worsened
	No change
	Improved
Mood	Worsened
	No change
	Improved
Memory	Worsened
	No change
	Improved
Quality of sleep	Worsened
	No change
	Improved
Stamina	Worsened
	No change
	Improved

Table 5. Oral hygiene practices among dental students based on the current status of smoking

Category	Total N (%)	Smoking status None smoke	Smoking status VAPE smoke
Number of decayed D, filled F, and missing teeth M do you have?			
None	27 (26.7)	11	16
<3	36 (35.6)	22	14
>3	38 (37.6)	25	13
How many times do you brush your teeth per day?			
None	2 (2)	1	1
Once a day	43 (42.6)	24	19
Twice and more	56 (55.4)	33	23
Do you use fluoride containing toothpaste?			
Yes	72 (71.3)	46	26
No	14 (13.9)	7	7
I don't know	15 (14.9)	5	10
How often do you eat sweets or drink sugary soft drinks?			
Daily	42 (41.6)	24	18
Weekly	42 (41.6)	26	16
Rarely	17 (16.8)	8	9
Do you use other oral-care devices besides toothbrush and toothpaste?			
Yes	48 (47.5)	31	17
No	53 (52.5)	27	26
How often do you visit your dentist?			
1-2 times a year	24 (23.8)	15	9
<2 times a year	19 (18.8)	9	10
Rarely	58 (57.4)	34	24

Table 6. Perceived related effects/events among dental students based on the current status of smoking

Have you experienced the following problems in the last month?	Total	Smoking status None smoke	Smoking status VAPE smoke	P value
chest pain	1	0	1	
The inflammation of the throat or larynx	2	1	2	
Gingivitis	2	1	1	0.001**
Headache	8	3	5	
Cough	18	4	14	
dry mouth	29	11	18	
without symptoms	41	29	12	

Table 7. Perceived physiological functions among dental students based on the current status of smoking

Have you experienced changes in the following physiological functions in the past month?	Total	Smoking status		P value
		None smoke	VAPE smoke	
Physical status				
No change	75	42	33	
Improved	11	9	2	0.17
Worsened	15	7	8	
Smell				
No change	94	55	39	
Improved	0	0	0	0.41
Worsened	7	3	4	
Taste				
No change	96	56	40	
Improved	2	1	1	0.67
Worsened	3	1	2	
Breathing				
No change	76	48	28	
Improved	2	2	0	0.02*
Worsened	23	8	15	
Appetite				
No change	77	47	30	
Improved	11	6	5	0.30
Worsened	13	5	8	
Mood				
No change	54	31	23	
Improved	19	7	12	0.06
Worsened	28	20	8	
Memory				
No change	73	41	32	
Improved	7	6	1	0.27
Worsened	21	11	10	
Quality of sleep				
No change	62	30	32	
Improved	14	11	3	0.05*
Worsened	25	17	8	
Fitness				
No change	63	40	23	
Improved	12	11	1	0.00**
Worsened	26	7	19	

Table 7 highlights the self-reported changes in physiological functions within the past month as reported by respondents. Overall, a majority reported "no change" in their physiological functions (54–96 %). The chi-Square test of independence apply to evaluate whether there were significant differences in reported changes in various physiological functions over the past month between non-smokers and vape smokers. For outcomes with low expected frequencies, Fisher's Exact Test was applied to ensure the validity of our findings. a significant difference between E-cigarette user and non-user in breathing, quality of sleep and fitness, p value (0.002, 0.05 and 0.00 respectively).

DISCUSSION

In this study, a noteworthy percentage of 43% of VAPE smokers, which marks up the increased adoption of this habit within the studied group, that in turn highlights and explains the wide distribution of this habit within the young sampled age group of males ranging approximately from 20- to 23-year-olds. Within the group of users, it has been found out that the users of nicotine salts E-liquids were almost as double as freebase nicotine E-liquid users, which reflects upon the higher acceptability of nicotine salts products for users, this finding can be attributed to these products having a more profound flavoring with less bitterness to mask and being overall more palatable.[13]

In terms of the reported DMFT and oral hygiene practices disregarding the smoking status, the frequency of brushing and DMFT of the students are remarkable as the subjects are held to a higher standard of oral health awareness. Dental students are generally more educated about oral health, which makes them more aware of the importance of maintaining good oral hygiene practices. This awareness can lead to better oral hygiene routines, including frequent tooth brushing, flossing, and regular dental check-ups, which might mitigate the expected negative impact of smoking or vaping on dental health.[14]

Another worth mentioning finding is the prevalence of dry mouth among VAPE smokers, which was more than twice as higher than non-users, which shares correlation with recent studies,[15] this can be attributed to the habit requiring constant oral inhalation and/or the hygroscopic nature of VG and PG making them absorb moisture from oral cavity, moreover, a group of users complained of cough, the possible explanation is irritant effect of nicotine, VG and PG elements of aerosol.[16,17]

Chronic dry mouth, known as xerostomia, plays a significant role in oral health problems like tooth decay and gum disease by compromising the protective functions of saliva. Saliva is essential for washing away food particles, balancing the acids produced by bacteria, and supplying vital minerals that help repair tooth enamel. When saliva production is insufficient, the mouth becomes more acidic, which increases the likelihood of cavities. Additionally, low saliva levels disrupt the natural balance of bacteria in the mouth, allowing harmful microorganisms to thrive and form plaque. This can lead to gum inflammation and gingivitis.[18,19]

Putting the physiologic function under the scope, more E-cigarettes users reported reduced quality of breathing,

which shares correlation with a study done by Zhang, Q. and Wen, C,[20] they participant also complained of loss of fitness, which particularly consistent with the recent studies.[21,22]

While the connection between vaping and compromised physiological functions like fitness and breathing is acknowledged, it deserves a more thorough examination. Vaping often introduces harmful substances into the lungs, which can lead to inflammation and reduced lung capacity over time.[23] This can significantly affect overall fitness levels, making it more difficult to engage in physical activities or exercise efficiently. Additionally, the chemicals found in vape products, such as nicotine and various flavorings, can interfere with the body's oxygen transport system, leading to breathlessness during exertion.[24] Within the topic of E-cigarettes effects on the oral cavity, despite the ongoing research, there's still a wide field for future studies to discover, in which our study takes part in this new entity.

From this study can be concluded that E-cigarettes smoking is becoming more widely growing habit within the young age group, more oral and physiological consequences begin to rise, such as a significantly higher prevalence of mouth dryness, cough and ultimately, worsened bodily functions including a lower breathing quality and reduced level of fitness. These results underline the critical need for dental education programs to include comprehensive discussions about the risks associated with vaping, ensuring that future practitioners are well-well-resourced to address these emerging public health challenges. This study serves as a call to action for both awareness and further research to fully understand the implications of vaping within the dental community and beyond.

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