



ORIGINAL ARTICLE

The Epidemiology of Vaping amongst Adolescents in a Private School in Bahrain: A Pilot Study

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Abstract

Introduction: The use of electronic cigarettes, commonly known as vaping, has gained significant popularity worldwide in recent years. Bahrain, in particular, is witnessing a notable increase in vaping, especially among adolescents. Given this rising trend, it is essential to comprehensively analyze the epidemiology of vaping among this population.

Objectives: This study aimed to estimate the prevalence of vaping among different demographic groups, including age and gender. It also explored patterns and factors influencing vaping behavior, such as frequency, duration, and the reasons behind initiation and chronic use. Additionally, the study assessed adolescents' awareness of vaping's potential health risks and evaluated the effectiveness of a video intervention designed to educate them on these risks.

Methods: A cross-sectional survey was conducted among students in grades 6-12 at an international school in Bahrain. This study utilized a modified survey from the Centre for Disease Control (CDC) - The National Youth Tobacco Survey, combined with a video made by the authors, which emphasized the harmful effects of nicotine on the developing brain.

Results: A total of 531 students responded. Approximately 90% reported never vaping, while 10% had tried vaping. Among the users, 45.7% vaped daily, 17.1% weekly, and 37.1% monthly. Post-video, 66.7% of vaping students expressed a desire to quit. Furthermore, 88.3% of all students identified at least two vaping consequences, and 72.9% said they would discourage others from vaping.

Conclusion: This pilot study highlights the importance of understanding vaping patterns and risks among adolescents, providing crucial insights for future interventions.

Keywords: Vaping; Electronic nicotine delivery systems; ENDS; Youth; Tobacco; Video Intervention; Bahrain

Introduction

The use of electronic cigarettes, commonly known as vaping, has gained significant popularity worldwide in recent years.¹ Vaping devices deliver aerosolized nicotine and other solvents like propylene glycol, tobacco-specific nitrosamines (TSNAs), and volatile organic compounds in a non-traditional way, presenting a potential alternative to traditional combustible tobacco products.² While some perceive vaping as a less harmful option,³⁻⁶ concerns have risen regarding its long-term health effects, particularly with regard to cardiovascular health and its impact on public health.⁷⁻¹⁰ While studies have indicated that vaping is helpful for people trying to quit traditional cigarettes¹¹⁻¹³, it has also invariably generated a generation of smokers who would not have been introduced to nicotine otherwise.⁵ Given the rising popularity, there is a pressing need to comprehensively understand the epidemiology of vaping, including its prevalence, patterns of use, and potential health risks.

The prevalence of vaping has seen a drastic surge, particularly among young adults and adolescents, and Bahrain is experiencing a notable increase in use. A study by the Center for Disease Control¹⁴ assessed E-cigarette youth amongst youth. The study found that in the United States, vapes are the most widely used tobacco product among adolescents and that E-cigarette marketing is influencing youth to start or continue with this habit. In 2023, 2.1 million students in the United States used e-cigarettes.¹⁴ Of the 2.1 million, 1.56 million were high-school students, and 550,000 were middle school students. Concerningly, the study also reports that “nearly 1 in 2 U.S. youth who have tried e-cigarettes report current use”. These findings are similar to the previous year¹⁵, however, there has been a notable isolated spike in the number of middle school students who vape (380,000 in 2022). In England, the number of 11–18-year-old students who reported vaping has doubled from 3.3% in 2021 to 7.6 in 2023.¹⁶ As such, this rising trend warrants comprehensive analysis to further understand the epidemiology of vaping amongst this population in Bahrain. This rise in popularity can be attributed to various factors, including aggressive marketing campaigns, the perception of

vaping as a fashionable trend, and the belief that it is a safer alternative to smoking.¹⁷⁻²⁰ However, limited research has been conducted to investigate the extent of this phenomenon. To date, no nation-wide studies have been conducted to look at the impact of vaping regarding different population groups and various socioeconomic backgrounds.

This pilot study aims to bridge the gap in the literature to better understand the factors impacting the use of ENDS (Electronic Nicotine Delivery Systems) in adolescents. By initiating this pilot study, the researchers aim to lay the groundwork for future larger-scale investigations and policy interventions. This approach allows for initial data collection, exploratory analyses, and refinement of research methodologies in hopes of providing insights into the multifactorial nature of vaping behaviors and addiction.

The study aimed to estimate the prevalence of vaping among different demographic groups, including age and gender. Additionally, it explored patterns and determinants of vaping behavior, such as frequency, duration, and factors associated with initiation and chronic use. This study also looked at the level of understanding of the potential health risks associated with vaping among adolescents. It explored the effectiveness of video intervention in understanding the health risks of vaping among participants.

This pilot study's findings will contribute to the existing body of knowledge through exploratory analysis of the root causes of using ENDS. The results will inform future research endeavors, policy formulation, and targeted interventions aimed at harm reduction associated with vaping. Additionally, this study will serve as a crucial step toward understanding the evolving landscape of tobacco and nicotine consumption, helping public health officials and policymakers make evidence-based, informed decisions to protect the well-being of Bahraini adolescents.

Methodology

To achieve the above objectives, a cross-sectional survey was conducted among students from grades 6-12, aged 12-20, from an international school in the Kingdom of Bahrain in June 2023. The study

utilized a modified survey from the Centre for Disease Control (CDC) - The National Youth Tobacco Survey.²¹ The survey included questions about vaping prevalence, use patterns, motivations, and perceived benefits or harms. Students were also shown a video made by the authors that discussed vaping as a problem in today's society and highlighted the harmful effects of nicotine on the developing brain.²²⁻²⁵

Study design

This study adopted a cross-sectional design to evaluate the prevalence of vaping among Bahraini adolescents.

Sample selection

Students in middle and high school, ages 12-20, were recruited from an international school in the Kingdom of Bahrain. The school for this pilot study was chosen out of convenience and availability. All students present whose parents had given consent were allowed to participate in the study. The study did not include students who declined or whose parents had declined consent.

Data collection

A structured questionnaire was developed to collect data on the various aspects of vaping. The questionnaire included demographic data, vaping behaviors (frequency, duration, and types of vaping products used), reasons for vaping initiation, and perceived risks. Students were asked to complete a preliminary survey, watch the video, and complete a post-intervention survey. A barcode was made available for the students to scan to access the surveys. All surveys were conducted through Microsoft Forms. Two researchers were present to aid students. To ensure anonymity, faculty members were restricted from being present at the hall throughout the study.

Ethical considerations

Ethical approval was obtained from the Bahrain Defense Force- Royal Medical Services Ethics Review Board. Informed consent was obtained from the participants and their parents or legal guardians. Emphasis was made on the principle of voluntary

participation. Both students and their parents/guardians were allowed to ask the researchers questions. Confidentiality and anonymity of participants were prioritized and emphasized throughout the study.

Data analysis

Descriptive statistics were used to summarize the sample's demographic characteristics and the prevalence of vaping. Chi-square tests were conducted to examine associations between demographic factors and vaping behaviors. Additionally, analyses were conducted to study the effectiveness of informative videos as an intervention to properly educate youth about the harms associated with vaping. All analyses were done through IBM SPSS Statistics version 29.0.1.1 (244).

Results

Both pre and post-video survey results are summarized in Table 1. 540 students were present when conducting the study, and 531 students responded to the survey (98.4% response rate). Most students, approximately 90%, reported never vaping. Amongst those who have tried vaping, 45.7% vape daily, 17.1% vape weekly, and 37.1% monthly. Amongst the 10% of students who do smoke, 32% of them are unaware of the concentration of nicotine used in their vapes. About 15% used nicotine greater than or equal to 50 mg.

Before showing the students the video, when asked about the adverse effects of vaping, about 12% of students thought that there were no harmful effects, 7.5% of students said they were unaware of the harmful effects, and the rest agreed that there were adverse health effects associated with smoking. Post-video, the survey revealed that amongst students who vape, 66.7% of them wanted to quit vaping after learning the consequences of vaping. 88.3% of all students had learned of at least two consequences of vaping, and 80.8% of them said that they were unlikely to use a vape. 72.9% of all students also said that they would advise against vaping. 71.6% of students agree that there should be more awareness with regard to vaping in schools

Table 1: Pre and Post video survey

Pre-video survey		Crude OR	p-value
What is your gender?	Female	257	48.4
	Male	260	49
	Prefer not to say	14	2.6
	Total	531	100
How old are you?	Under 12	23	4.3
	12-14	316	59.5
	14-16	190	35.8
	16-18	1	0.2
	18-20	1	0.2
	Total	531	100
Which option best describes your vaping habits?	I have never tried vaping before	478	90
	I have tried vaping once	24	4.5
	I have vaped a few times	10	1.9
	I vape regularly	13	2.4
	I vape socially when my friends do it	6	1.1
	Total	531	100
Why did you start vaping?	Because my friends/family do it	13	2.4
	It is healthier than smoking	1	0.2
	It seems cool and fun	12	2.3
	Not applicable (never vaped before)	485	91.3
	To quit smoking	3	0.6
	To try something new	17	3.2
How often do you vape?	Daily	16	3
	Monthly	13	2.4
	Not applicable (never vaped before)	496	93.4
	Weekly	6	1.1
	Total	531	100
What strength of nicotine do you use in your vape?	1.5-3 mg	5	0.9
	24-30 mg	3	0.6
	30-36 mg	2	0.4
	50+ mg	15	2.8
	6-9 mg	3	0.6
	I'm not sure	17	3.2
	Nicotine free	8	1.5
	Not applicable (never vaped before)	478	90
	Total	531	100
Does a parent/guardian know about your vaping?	No	25	4.7
	Not applicable (never vaped before)	486	91.5
	Yes	20	3.8
	Total	531	100

Post- video survey			
	No	40	7.5
Do you know the health problems caused by vaping?	There are no problems	63	11.9
	Yes	428	80.6
	Total	531	100
	No	18	3.4
Did learning the consequences of vaping make you want to quit?	Not applicable (never smoked before)	477	89.8
	Yes	36	6.8
	Total	531	100
	No	34	6.4
Did you learn at least 2 consequences of smoking?	Not sure	28	5.3
	Yes	469	88.3
	Total	531	100
	Likely	15	2.8
How likely are you now to use a vape?	Neither likely or unlikely	29	5.5
	Somewhat likely	9	1.7
	Somewhat unlikely	49	9.2
	Unlikely	429	80.8
	Total	531	100
	No	55	10.4
Would you advise against vaping to someone?	Not sure	89	16.8
	Yes	387	72.9
	Total	531	100
	Extremely helpful	102	19.2
How helpful was the content presented at the event?	Not so helpful	57	10.7
	Somewhat helpful	219	41.2
	Very helpful	153	28.8
	Total	531	100
	No	151	28.4
Do you think schools should have more vaping awareness?	Yes	380	71.6
	Total	531	100

Table 2- Chi- squared analysis. The relationship between age and gender and vaping habits

	Which option best describes your vaping habits?					Total	
	I have never tried vaping before	I have tried vaping once	I have vaped a few times	I have vaped a few times	I vape socially when my friends do it		
Age	Under 12	19	1	2	1	0	23
	12-14	296	9	3	5	3	316
	14-16	163	14	5	6	2	190
	16-18	0	0	0	0	1	1
	18-20	0	0	0	1	0	1
	Total	478	24	10	13	6	531
Gender	Female	235	7	4	7	4	257
	Male	233	15	5	5	2	260
	Prefer not to say	10	2	1	1	0	14
	Total	478	24	10	13	6	531

Table 3: Chi- squared analysis. The relationship between vaping habits and reason for starting vaping

		Why did you start vaping?					Total
		Because my friends/family do it	It is healthier than smoking	It seems cool and fun	To quit smoking	To try something new	
Which option best describes your vaping habits?	I have tried vaping once	6	0	2	0	10	18
	I have vaped a few times	2	0	2	1	4	9
	I vape regularly	3	1	7	1	2	14
	I vape socially when my friends do it	2	0	2	0	2	6

Discussion

The results of this pilot study provide valuable insights into the epidemiology of vaping among youth and shed light on the prevalence, patterns, and associated factors of this behavior. The study first assessed the 10% of students who admitted to vaping. Almost 46% of those students who vape do so daily, with 17% vaping weekly and 37% monthly. Also, among that cohort, 15% of them used nicotine concentrations greater than or equal to 50 mg. There are no official laws prohibiting the sale of 50 mg/mL nicotine pods, and they are readily available at many local online and retail stores.²⁶ The prevalence of current vapers in the age demographic studied is higher than that in the USA (7.7%) in 2023¹⁴, and the UK (3.6%) for the same year.²⁷ In the UK, there was a 50% growth in experimentation with vaping devices from 2022 to 2023.²⁷ There are no previous statistics for Bahrain to compare, and the prevalence of vaping among adolescents in regional countries has not yet been studied. However, studies looking at the prevalence of university students are equally concerning. 23% of students in the United Arab Emirates, 27.7% in Saudi Arabia, and 14% in Qatar admitted to using E-cigarettes.²⁸

The demographic characteristics of age and gender were explored to identify potential variations in vaping prevalence. Of the students who have tried e-cigarettes, 55.1% identified as males, and 44.9%

identified as females. Research by Tehrani et al. (2022) found that worldwide, the lifetime prevalence of e-cigarette vaping was higher among men than women, 22% and 16%.¹ This gender discrepancy highlights the importance of considering gender factors in prevention efforts. About 60% of participants fell within the 12-14-year age group (see Table 2). However, the highest percentage of smokers (50.9%) were amongst the 14-16-year age group. The increase in use among older children has been demonstrated in several studies and may be due to increased exposure to e-cigarettes with age.²⁹ Although the highest percentage of smokers were amongst the 14-16-year age group, it should be noted that only two students from 531 were in the 16-18 and 18-20 age groups. This reflects the need to conduct more extensive studies to further examine the relationship between age and vaping. Previous studies have shown that among students who vape, the highest percentage of vapers belong to high school students, particularly in the United States, 4.6% out of 7.7%.¹⁴ Since 2019, the legal age for purchasing tobacco products in the United States has changed from 18 to 21 years old.³⁰ Although the sale of E-cigarettes to those under the age of 18 is prohibited in Bahrain³¹, it is clear that it has not prevented the students from obtaining these devices. The reasons and methods behind obtaining vapes illegally in the study population are beyond the scope of this study. However, it is

reasonable to blame the ease of online purchasing at least partially as a contributor.

This study also looked at reasons for vaping initiation. In this study, from the students who have tried e-cigarettes, the three most common answers as to why they started were “to try something new” (38.3%), “Because my friends/family do it” (27.7%), “It seems cool and fun” (27.7%). A comparable study conducted by Wang et al. (2019)³², reported higher prevalence rates of youth vaping in the United States. However, when exploring the reasons for e-cigarette initiation, similar results were observed. In both studies, one of the three most common reasons as to why they started vaping was “because my friends/family do it” (27.7% and 30.8%, respectively). Research by Kong et al. (2015)³³, similarly revealed that curiosity motivated adolescents to vape (54.4%). Recognizing the motivations behind e-cigarette initiation is crucial to understanding the underlying factors driving its popularity and for the development of prevention strategies such as comprehensive education programs. These programs should focus on understanding the motivating factors by providing information about the risks associated with vaping, and the impact friends and family have on this impressionable population.

One of the study’s objectives was to explore the students’ understanding of potential health risks associated with vaping. When asked about the adverse effects of vaping before showing the video, about 12% of student responders thought that there were no harmful effects, 7.5% of students said they were unaware of the harmful effects, and the rest agreed that there are adverse health effects associated with smoking. This is a dangerously false perception, as the health consequences of vaping are continuously being revealed. These include the effects of nicotine on the developing brain and its ability to decline cognition and affect memory impairment in adolescents.¹⁵ The flavorings and additives also harm adolescents, and they have been proven to contain carcinogens and harness the ability to impair mucociliary function in bronchial epithelial cells.¹⁵ Countries like the USA have also reported an epidemic of E-cigarette or Vaping

Product-use Associated Lung Injury (EVALI) that started in 2019.³⁴ According to Zulfikar, Sankari, and Rahman³¹, EVALI is an “acute or subacute respiratory illness characterized by a spectrum of clinicopathologic findings mimicking various pulmonary diseases.” Although Vitamin E acetate, a condensing agent, is seemingly the culprit behind EVALI,^{31,34} the etiology remains unclear. These harmful consequences were highlighted in the video shown to the students after completing the preliminary survey.

This study assessed the perceptions of the students with regard to e-cigarette use after watching the informative video discussing the harms of vaping. With regards to the 10% of e-cigarette users, 66.7% reported wanting to quit vaping after learning about the consequences vaping had on their health. 88.3% of all students had learned of at least 2 consequences of vaping, and 80.8% of them said that they were unlikely to use a vape. 72.9% of all students also said that they would advise against vaping. Additionally, 71.6% of all students believed schools should have more vaping awareness programs. This highlights the impact education can have on addressing this global health concern. According to a study by Jones et al. (2020)³⁵, it appears that adolescents obtain vaping-related information from social media platforms and their peers. This study additionally found that while parents rely on schools to educate their children on e-cigarettes, students continue to receive minimal resources about this topic. This emphasizes how crucial it is to use social media platforms to spread focused anti-vaping initiatives and correct information to offset the impact of false content. A study published in 2020 by Chaplin et al.³⁶ similarly assessed the effectiveness of video intervention in improving high school student's knowledge of the health effects of vaping and concluded the intervention was successful.

In summary, this pilot study adds to the body of research on the epidemiology of juvenile vaping by shedding light on prevalence rates, related factors, initiation reasons, and information sources. This study is, as expected, consistent with similar research published, and highlights the need to expand on vaping in our youth, especially in the region. A more thorough understanding of juvenile

vaping can enable the creation of more efficient preventative and intervention plans to combat this public health issue. By addressing the reasons for vaping initiation and continuation, the study serves as a foundation to further expand on the issue of adolescent vaping and the urgent need for public health campaigns to address this matter.

Limitations and Future Considerations

The study's limitations include self-reported data, which may be subject to recall and social desirability biases. These biases potentially lead to under- or over-reporting of vaping behaviors. Moreover, these biases have resulted in minor inconsistencies across the data collected. Across both surveys, some inconsistencies were noted across the data collected (i.e., the student selected I have never vaped/Not applicable for one question, but the reason for vaping was to quit smoking for a different question). Inconsistent entries were considered in the survey summary tables but removed from the final data analysis.

Second, the generalizability of the findings may be limited to the socioeconomic demographic and specific age group studied, as the population was limited to students attending a privately funded school. However, this pilot study provides a valuable foundation for future research on the epidemiology of vaping among Bahraini youth. The results contribute to the existing literature and can inform evidence-based interventions and policies aimed at reducing vaping prevalence and protecting the health of young individuals. Future research should aim to include diverse populations and expand the sample size to enhance generalizability.

Conclusion

In conclusion, this pilot study highlights the importance of understanding the epidemiology of vaping among adolescents. By investigating the prevalence, patterns, and associated factors of vaping, this study provides valuable insights that can guide future research and targeted interventions. It is crucial to continue studying this issue to develop comprehensive strategies that effectively address the public health concerns associated with youth vaping. Ultimately, this study serves as a critical foundation for future endeavors

and policy development to address the complexity of vaping patterns. In fostering a deeper understanding of the epidemiology of vaping, this body of research contributes to the collective efforts to safeguard public health and protect adolescents' well-being in the face of evolving patterns of substance abuse and their associated health implications.

By conducting this pilot study, we aim to lay the foundation for future larger-scale research on the epidemiology of vaping among youth. The findings will contribute to developing evidence-based interventions and policies to reduce vaping prevalence and protect the health of young individuals in society.

References

1. Tehrani H, Rajabi A, Ghelichi-Ghojogh M, Nejatian M, Jafari A. The prevalence of electronic cigarettes vaping globally: a systematic review and meta-analysis. *Arch Public Health*. 2022;80(1):240. Published 2022 Nov 21. doi:10.1186/s13690-022-00998-w
2. National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Population Health and Public Health Practice; Committee on the Review of the Health Effects of Electronic Nicotine Delivery Systems; Eaton DL, Kwan LY, Stratton K, editors. *Public Health Consequences of E-Cigarettes*. Washington (DC): National Academies Press (US); 2018 Jan 23. 5, Toxicology of E-Cigarette Constituents. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK507184/>
3. Patel T, Karle E, Gubeladze T, Pentecost G, Krvavac A. Patient Perception of Vaping in the Midst of the Electronic Cigarette and Vaping Product Associated Lung Injury (EVALI) Epidemic. *Mo Med*. 2020;117(3):265-270.
4. Thoonen KAHJ, Jongenelis MI. Perceptions of e-cigarettes among Australian adolescents, young adults, and adults. *Addict Behav*. 2023;144:107741. doi:10.1016/j.addbeh.2023.107741
5. Jongenelis MI, Kameron C, Rudaizky D, Slevin T, Pettigrew S. Perceptions of the harm, addictiveness, and smoking cessation

- effectiveness of e-cigarettes among Australian young adults. *Addict Behav.* 2019;90:217-221. doi:10.1016/j.addbeh.2018.11.004
6. Wilson S, Partos T, McNeill A, Brose LS. Harm perceptions of e-cigarettes and other nicotine products in a UK sample. *Addiction.* 2019;114(5):879-888. doi:10.1111/add.14502
 7. Nyilas S, Bauman G, Korten I, et al. MRI Shows Lung Perfusion Changes after Vaping and Smoking. *Radiology.* 2022;304(1):195-204. doi:10.1148/radiol.211327
 8. Antoniewicz L, Brynedal A, Hedman L, Lundbäck M, Bosson JA. Acute Effects of Electronic Cigarette Inhalation on the Vasculature and the Conducting Airways. *Cardiovasc Toxicol.* 2019;19(5):441-450. doi:10.1007/s12012-019-09516-x
 9. Warren KJ, Beck EM, Callahan SJ, et al. Alveolar macrophages from EVALI patients and e-cigarette users: a story of shifting phenotype. *Respir Res.* 2023;24(1):162. Published 2023 Jun 17. doi:10.1186/s12931-023-02455-w
 10. Goebel I, Mohr T, Axt PN, et al. Impact of Heated Tobacco Products, E-Cigarettes, and Combustible Cigarettes on Small Airways and Arterial Stiffness. *Toxics.* 2023;11(9):758. Published 2023 Sep 6. doi:10.3390/toxics11090758
 11. Bonevski B, Manning V, Wynne O, et al. QuitNic: A Pilot Randomized Controlled Trial Comparing Nicotine Vaping Products With Nicotine Replacement Therapy for Smoking Cessation Following Residential Detoxification. *Nicotine Tob Res.* 2021;23(3):462-470. doi:10.1093/ntr/ntaa143
 12. Li J, Hui X, Fu J, Ahmed MM, Yao L, Yang K. Electronic cigarettes versus nicotine-replacement therapy for smoking cessation: A systematic review and meta-analysis of randomized controlled trials. *Tob Induc Dis.* 2022;20:90. Published 2022 Oct 20. doi:10.18332/tid/154075
 13. Hartmann-Boyce J, Lindson N, Butler AR, et al. Electronic cigarettes for smoking cessation. *Cochrane Database Syst Rev.* 2022;11(11):CD010216. Published 2022 Nov 17. doi:10.1002/14651858.CD010216.pub7
 14. E-cigarette use among youth (no date) Centers for Disease Control and Prevention. Available at: [https://www.cdc.gov/tobacco/e-cigarettes/youth.html#:~:text=In%20the%20United%20States%2C%20youth%20use%20e%2Dcigarettes%20more,than%20any%20other%20tobacco%20product.&text=2.1%20million%20\(7.7%25\)%20students,4.6%25\)%20middle%20school%20students.](https://www.cdc.gov/tobacco/e-cigarettes/youth.html#:~:text=In%20the%20United%20States%2C%20youth%20use%20e%2Dcigarettes%20more,than%20any%20other%20tobacco%20product.&text=2.1%20million%20(7.7%25)%20students,4.6%25)%20middle%20school%20students.) (Accessed: 28 June 2024).
 15. FDA Center for Tobacco (no date) 2022 Findings on Youth E-Cigarette Use, Results from the Annual National Youth Tobacco Survey - Tobacco Education Resource Library Web Pages. Available at: [https://digitalmedia.hhs.gov/tobacco/webpages/3327#:~:text=2022%20Findings%20on%20Youth%20E%2DCigarette%20Use,-In%20October%202022&text=In%202022%2C%20about%201%20in,\(past%2030%2Dday\).&text=14.1%25%20\(2.14%20million\)%20of,reported%20current%20e%2Dcigarette%20use.](https://digitalmedia.hhs.gov/tobacco/webpages/3327#:~:text=2022%20Findings%20on%20Youth%20E%2DCigarette%20Use,-In%20October%202022&text=In%202022%2C%20about%201%20in,(past%2030%2Dday).&text=14.1%25%20(2.14%20million)%20of,reported%20current%20e%2Dcigarette%20use.) (Accessed: 28 June 2024).
 16. Use of e-cigarettes among young people in Great Britain. Available at: <https://ash.org.uk/resources/view/use-of-e-cigarettes-among-young-people-in-great-britain> (Accessed: 20 June 2024).
 17. Jones K, Salzman GA. The Vaping Epidemic in Adolescents. *Mo Med.* 2020;117(1):56-58.
 18. Pu J, Zhang X. Exposure to advertising and perception, interest, and use of e-cigarettes among adolescents: findings from the US National Youth Tobacco Survey. *Perspect Public Health.* 2017;137(6):322-325. doi:10.1177/1757913917703151
 19. Do VV, Nyman AL, Kim Y, Emery SL, Weaver SR, Huang J. Association between E-Cigarette Advertising Exposure and Use of E-Cigarettes among a Cohort of U.S. Youth and Young Adults. *Int J Environ Res Public Health.*

- 2022;19(19):12640. Published 2022 Oct 3. doi:0.3390/ijerph191912640
20. Wang Y, Duan Z, Weaver SR, et al. Association of e-Cigarette Advertising, Parental Influence, and Peer Influence With US Adolescent e-Cigarette Use. *JAMA Netw Open*. 2022;5(9):e2233938. Published 2022 Sep 1. doi:10.1001/jamanetworkopen.2022.33938
 21. National Youth Tobacco Survey (NYTS). Centers for Disease Control and Prevention. March 14, 2022. Accessed December 31, 2023.
 22. Goriounova NA, Mansvelder HD. Short- and long-term consequences of nicotine exposure during adolescence for prefrontal cortex neuronal network function. *Cold Spring Harb Perspect Med*. 2012;2(12):a012120. Published 2012 Dec 1. doi:10.1101/cshperspect.a012120
 23. Yuan M, Cross SJ, Loughlin SE, Leslie FM. Nicotine and the adolescent brain. *J Physiol*. 2015;593(16):3397-3412. doi:10.1113/JP270492
 24. Smith RF, McDonald CG, Bergstrom HC, Ehlinger DG, Brielmaier JM. Adolescent nicotine induces persisting changes in development of neural connectivity. *Neurosci Biobehav Rev*. 2015;55:432-443. doi:10.1016/j.neubiorev.2015.05.019
 25. Rodriguez-Vega A, Dutra-Tavares AC, Souza TP, et al. Nicotine Exposure in a Phencyclidine-Induced Mice Model of Schizophrenia: Sex-Selective Medial Prefrontal Cortex Protein Markers of the Combined Insults in Adolescent Mice. *Int J Mol Sci*. 2023;24(19):14634. Published 2023 Sep 27. doi:10.3390/ijms241914634
 26. VGOD 30ML 20MG Berry Bomb (2024) Vape in Bahrain. Available at: <https://www.vapeinbahrain.bh/product/vgod-salt-berry-bomb-30ml-2/> (Accessed: 21 June 2024).
 27. Use of e-cigarettes among young people in Great Britain. Available at: <https://ash.org.uk/resources/view/use-of-e-cigarettes-among-young-people-in-great-britain> (Accessed: 20 June 2024).
 28. Al-Hamdani M, Brett Hopkins D. E-cigarettes in the Middle East: The known, unknown, and what needs to be known next. *Prev Med Rep*. 2022;31:102089. Published 2022 Dec 7. doi:10.1016/j.pmedr.2022.102089
 29. Perikleous EP, Steiropoulos P, Paraskakis E, Constantinidis TC, Nena E. E-Cigarette Use Among Adolescents: An Overview of the Literature and Future Perspectives. *Front Public Health*. 2018;6:86. Published 2018 Mar 26. doi:10.3389/fpubh.2018.00086
 30. Products, C. for T. (no date) Tobacco 21, U.S. Food and Drug Administration. Available at: <https://www.fda.gov/tobacco-products/retail-sales-tobacco-products/tobacco-21> (Accessed: 22 June 2024).
 31. Yousef, M. (2024) Bahrain: E-cigarette regulation, January 2024, ECigIntelligence. Available at: <https://ecigintelligence.com/bahrain-e-cigarette-regulation-january-2024/> (Accessed: 21 June 2024).
 32. Wang TW, Gentzke AS, Creamer MR, et al. Tobacco Product Use and Associated Factors Among Middle and High School Students - United States, 2019. *MMWR Surveill Summ*. 2019;68(12):1-22. Published 2019 Nov 6. doi:10.15585/mmwr.ss6812a1
 33. 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(7):847-854. doi:10.1093/ntr/ntu257
 34. Mado H, Reichman-Warmusz E, Wojnicz R. The vaping product use associated lung injury: is this a new pulmonary disease entity?. *Rev Environ Health*. 2020;36(2):145-157. Published 2020 Dec 7. doi:10.1515/reveh-2020-0076
 35. Jones K, Salzman GA. The Vaping Epidemic in Adolescents. *Mo Med*. 2020;117(1):56-58.
 36. ChaplinMD, BrogieJ, BurchA, et al. Effectiveness of an educational intervention on health risks of vaping for high school-aged adolescents. *J Am Pharm Assoc (2003)*. 2020;60(6):e158-e161. doi:10.1016/j.japh.2020.05.008