

Prevalence of electronic cigarette Smoking and its Related Behaviors and Beliefs Among high School Students in Makkah, Saudi Arabia

ABSTRACT

Background: The rapid rise of electronic cigarette (e-cigarette) use among adolescents has become a global public health concern. This study aimed to determine the prevalence of e-cigarette use among high school students in Makkah and explore related behaviors, beliefs, and influencing factors.

Methods: A cross-sectional study was conducted among 476 high school students (grades 10-12) selected through multi-stage stratified random sampling. Data were collected using an adapted version of the CDC's National Youth Tobacco Survey (NYTS) and analyzed using SPSS version 28. Descriptive statistics, chi-square tests, and logistic regression were employed to examine associations.

Results: Overall, 27.1% of students reported ever using e-cigarettes, with initiation commonly occurring between ages 12–15. Current use within the past 30 days was reported by 71.2% of users. The most cited reasons for use included family member influence (62.2%) and curiosity (23.3%). Fruit-flavored (93.3%) and nicotine-containing (88.9%) products were most popular, with Mazag being the dominant brand. Nearly half (41.9%) reported purchasing e-cigarette products on school property. Logistic regression revealed significant predictors of use included older age (OR=1.74), higher grade level (OR=1.62), higher weekly spending (OR=1.19), father's smoking status (OR=2.46), and mother's smoking status (OR=8.00). Most users (56.2%) had no intention to quit within 12 months, though 62.9% had attempted quitting in the past year.

Conclusion: This study reveals alarmingly high e-cigarette use among Makkah adolescents, influenced by accessibility, flavors, and family factors. The findings underscore the urgent need for school-based interventions, stricter sales regulations, and targeted prevention programs addressing the unique cultural and social drivers of youth vaping in Saudi Arabia. Policy measures should prioritize flavor restrictions and improved cessation resources to curb this emerging public health crisis.

Keywords: Electronic cigarettes, adolescents, Saudi Arabia, prevalence, risk factors, tobacco control

INTRODUCTION

Electronic cigarettes (e-cigarettes) have consistently gained popularity and are often marketed as a safer alternative to conventional cigarettes and as smoking cessation aids [1]. Since their introduction in the early 2000s, e-cigarette use has surged, particularly among adolescents and young adults [2]. This trend is alarming, as e-cigarettes may pave the way to traditional tobacco smoking or lead to nicotine addiction, despite being perceived as safer [3,4]. In Saudi Arabia, where tobacco control policies mainly target conventional smoking, e-cigarettes pose a huge health concern, especially for the younger generation [5,6].

The Kingdom of Saudi Arabia (KSA) has a growing prevalence of e-cigarette use; however, there is limited research conducted on its adoption among high school students [1]. Existing studies have mainly focused on university students and other adult populations, revealing high usage rates and misconceptions about e-cigarettes' safety. For instance, studies among university students in KSA reported that 13% of males and 2.4% of females smoked conventional cigarettes, with regional variations [7]. However, data on adolescent e-cigarette use (critical for shaping preventive strategies) remain scarce, while the adolescent period is the most risky, where most start smoking.

Globally, evidence indicates that adolescent e-cigarette use is influenced by several factors, including flavors, aggressive marketing, and the perception of less harm of e-cigarettes compared to traditional cigarettes [8,9]. For example, 20% of adolescents in the United Kingdom reported current e-cigarette use as a way to minimize risks associated with traditional cigarettes, with many citing health concerns or cessation attempts as motivations [10]. Similar perceptions might exist in the KSA, pushing the adolescents to e-cigarettes despite the consideration that local cultural norms and restricted tobacco advertising could differently influence smoking patterns. The lack of local data on adolescents' knowledge, attitudes, and behaviors toward e-cigarettes in the KSA negatively impacts the development of targeted interventions.

This study aimed to address this gap by investigating the prevalence of e-cigarette use among high school students in Makkah, Saudi Arabia, and exploring associated behaviors and beliefs. The study assessed reasons for initiation, attitudes, abstinence motivations, and the influence of teachers. Understanding e-cigarette use among Saudi adolescents is vital for informing public health policies and educational campaigns. Given the potential for e-cigarettes to undermine tobacco control efforts, this study contributes to the limited regional evidence base, aligning with global goals like Healthy People 2030 targets of reducing youth tobacco use [11]. The findings may guide regulatory measures and school-based interventions to curb e-cigarette adoption and correct misconceptions about their safety.

METHODS

Study Design and Setting

The analytical cross-sectional study was carried out on male and female high school students in Makkah, the capital of Makkah Province. The main reason for selecting this city is due to its large adolescent population and the paucity of prior research conducted on the use of e-cigarettes in this population in the region.

Target Population and Sampling Strategy

The target population included students in grades 10 to 12 from public and private high schools in Makkah. The participants who met the criteria were students currently attending these schools and willingly consented to participate in the study. Exclusion criteria consisted of students from night schools or adult schools, students attending special needs education schools, and students with learning disabilities that interfere with the understanding of the questionnaire.

In order to achieve representativeness, a multi-stage stratified random sampling method was implemented. In the first stage (District Selection), Makkah was split into nine administrative districts. From these, two districts were randomly selected. In the second stage (School Selection), schools within the selected districts were stratified by gender (male/female) and also by the type of school (governmental/private). From each stratum, one governmental and one private school were randomly selected proportional to their size. The final stage involved student selection. Within each selected school, the sample was spread evenly across grades (10, 11, and 12). A single class per grade was randomly chosen, and all students in that class were invited to participate.

Sample Size Calculation

The sample size was determined through EPI-INFO 7 software with the assumption of a 50% prevalence rate of e-cigarette use (due to the absence of local data), 95% confidence level, and 5% margin of error. Initial calculations indicated that at least 384 students would be needed. To buffer against non-responses, an additional 20% was used, leading to a total of approximately 460 students.

Data Collection Tool and Process

As for the data collection tool, the self-administered questionnaire used was adapted from the U.S. Centers for Disease Control and Prevention (CDC)'s National Youth Tobacco Survey (NYTS)-2020 [12]. It included a demographic section with questions on age, gender, grade level, and school type. Following this were sections on patterns of e-cigarette usage (including lifetime, current use,

frequency, brands, and flavor preferences), reasons for using e-cigarettes (curiosity, peer pressure, or perceived low risk), and attitudes toward e-cigarettes (including health risks, social acceptance, etc.). Other items pertained to non-smoking residents, such as motivators for remaining abstinent as well as attitudes toward smoking peers. The questionnaire also inquired about external factors, such as what other students believe about e-cigarettes and what teachers, family, and media influence students to believe about e-cigarettes.

Before the start of data collection, a pilot test was conducted with 92 students (20% of the estimated sample) focusing on refining the questionnaire, and these students were excluded from the final data collection to reduce bias. During data collection, in-class student participants completed the survey during school hours under the guidance of trained research assistants. To maintain a controlled environment, the distribution of the surveys took place in the presence of teachers, and students completed them within the time frame of 15 to 20 minutes.

Statistical Analysis

This study's data analysis was performed using SPSS version 28 (IBM Corporation, 2021). To evaluate the factors for e-cigarette use among high school students in Makkah, Saudi Arabia, several statistical approaches were applied. Initially, descriptive statistics, which include e-cigarette usage patterns among demographic participants, were analyzed. Categorical variables such as age, gender, and grade level were included, and frequencies and percentages were utilized. Bivariate analyses were conducted to explore the relationships among factors and e-cigarette use. To test the association between the variables, chi-square tests (Pearson's Chi-square or exact probability tests when applicable) were applied for the multicategorical variables of e-cigarette usage such as age and gender, and parental smoking status. The level of significance for these tests was set at $p < 0.05$. Some specific predictors of e-cigarette use and engagement for multivariate logistic regression were defined. The remaining potential confounding variables were controlled for "factors" role, and Odd Ratios (OR) with 95% CIs were calculated to determine the strengths of the associations between cigarette use and its predictors.

Ethical Considerations

Personal identifiers were not collected to preserve anonymity. Ethical approval was secured from the IRB and the Saudi Arabia's Ministry of Education. The relevant school managers and the teaching faculty were briefed on the goal and manner of execution of the

study. Participation was voluntary and consent was fully obtained from the parents or legal guardians of students, and the assent was also obtained from the students themselves before the start of data collection.

RESULTS

Table 1 shows the bio-demographic characteristics of 476 high school students in Makkah, Saudi Arabia. Most students were aged 17 years (No=169, 35.5%) and male (No=261, 54.8%). The majority were in 12th grade (No=190, 39.9%). Most were medically free (No=435, 91.4%), with a few reporting asthma (No=30, 6.3%), mental illness (No=16, 3.4%), or experiencing domestic violence (No=22, 4.6%). Only 19.3% (No=92) exercised regularly. Weekly spending varied, with 23.7% (No=113) spending over 100 SR. Most fathers (No=198, 41.6%) and mothers (No=181, 38.0%) had a bachelor's degree. Employed fathers were reported by 52.9% (No=252), while 30.7% (No=146) had both parents working. About 26.1% (No=124) reported a family income of 10,000–20,000 SR, while 37.0% (No=176) did not know. Smoking was reported in 26.3% of fathers (No=125) and 9.2% of mothers (No=44). The data show that 27.1% (No=129) of students reported having ever used an e-cigarette, even if only once or twice, while the majority (72.9%, No=347) reported never having used one.

Table 1. Bio-Demographic Characteristics of The Study High School Students in Makkah, Saudi Arabia (N=476)

Bio-demographic data	No	%
Age in years	13-15	58 12.2%
	16	154 32.4%
	17	169 35.5%
	18-19	95 20.0%
Gender of participants	Male	261 54.8%
	Female	215 45.2%
Grade of participants	10th grade	119 25.0%
	11th grade	167 35.1%
	12th grade	190 39.9%
Chronic disease of participants	Diabetes	5 1.1%
	Heart Diseases	6 1.3%
	Asthma	30 6.3%
	Medically free	435 91.4%

Participants who have ever been diagnosed with a mental illness	Yes	16	3.4%
	No	460	96.6%
Participants who have ever experienced domestic violence	Yes	22	4.6%
	No	454	95.4%
Exercise regularly	Yes	92	19.3%
	Some times	304	63.9%
	No	80	16.8%
Amount of money spent per week	Don't spent	40	8.4%
	< 10 SR	37	7.8%
	10-30 SR	104	21.8%
	30-50 SR	102	21.4%
	50-100 SR	80	16.8%
	> 100 SR	113	23.7%
Father's level of education	Illiterate	7	1.5%
	Primary school	12	2.5%
	Secondary school	23	4.8%
	High school	94	19.7%
	Diploma	36	7.6%
	Bachelor	198	41.6%
	Higher education	53	11.1%
	I don't know	53	11.1%
Mother's level of education	Illiterate	7	1.5%
	Primary school	14	2.9%
	Secondary school	37	7.8%
	High school	98	20.6%
	Diploma	43	9.0%
	Bachelor	181	38.0%

	Higher education	34	7.1%
	I don't know	62	13.0%
Parents' occupational status	Father working	252	52.9%
	Mother working	13	2.7%
	Both father and mother) working	146	30.7%
	Both father and mother) not working	52	10.9%
	I don't know	13	2.7%
Family income	Less than 10000 riyals	69	14.5%
	From 10000-20000 riyals	124	26.1%
	More than 20000 riyals	107	22.5%
	I don't know	176	37.0%
Father smoking status: (in any form)	Yes	125	26.3%
	No	351	73.7%
Mother smoking status: (in any form)	Yes	44	9.2%
	No	432	90.8%

Table 2 provides the e-cigarette use patterns among high school students in Makkah, Saudi Arabia. Among those who had used e-cigarettes, the most common age of first use was between 12–15 years (No=56, 43.4%), followed by under 12 years (No=41, 31.8%). A smaller proportion (No=32, 24.8%) initiated use after age 15. Regarding lifetime use, nearly half (No=61, 47.3%) of users reported having used e-cigarettes on more than 100 days. Only 18.6% (No=24) had used them just once, and 14.7% (No=19) reported using them on 2–10 days. Recent use was also common, with 38.0% (No=49) reporting use earlier on the same day of the survey, and 21.7% (No=28) within the past week. Another 10.1% (No=13) reported use within the past 30 days. When exploring reasons for initial use, the most cited factor was influence from a family member who used e-cigarettes (No=68, 52.7%), followed by curiosity (No=54, 41.9%) and peer influence (No=49, 38.0%). Other reasons, such as stress relief (No=4, 3.1%), ease of access (No=3, 2.3%), and the desire to get a nicotine buzz (No=3, 2.3%), were less commonly reported. A small number of students cited concealability at home/school or performing tricks as reasons for use. Alarming, 41.9% (No=54) of those who had used e-cigarettes reported purchasing a device or related product while on school property.

Table 2. E-Cigarette Use Frequency, Initiation, and Behaviors Among High School Students in Makkah, Saudi Arabia
(N=129)

Pattern	No	%
Age at first use of e-cigarette, even once or twice?		
< 12 years	41	31.8%
12-15 years	56	43.4%
> 15 years	32	24.8%
In total, how many days have you used e-cigarettes in your entire life?		
1 day	24	18.6%
2 to 10 days	19	14.7%
11 to 20 days	5	3.9%
21 to 50 days	8	6.2%
51 to 100 days	12	9.3%
Over 100 days	61	47.3%
When was the last time you used an e-cigarette, even one or two times?		
Earlier today	49	38.0%
Not today, but sometime during the past 7 days	28	21.7%
Not during the past 7 days, but sometime during the past 30 days	13	10.1%
Not during the past 30 days, but sometime during the past 6 months	9	7.0%
Not during the past 6 months, but sometime during the past year	11	8.5%
1 to 4 years ago	15	11.6%
5 or more years ago,	4	3.1%
Why did you first use an e-cigarette?		
A family member used them	68	52.7%
I was curious about them	54	41.9%
A friend used them	49	38.0%
I was feeling anxious, stressed, or depressed	4	3.1%

They were easier to get than other tobacco products, such as cigarettes	3	2.3%
To get a high or buzz from nicotine	3	2.3%
To try to quit using other tobacco products, such as cigarettes	2	1.6%
I could use them unnoticed at home or school	2	1.6%
I could use them to do tricks	1	0.8%
Have you ever purchased an e-cigarette device (including disposable devices), pod, cartridge, single hit, or e-liquid refill while at school or on school property?		
Yes	54	41.9%
No	75	58.1%

Table 3 illustrates the current e-cigarette use patterns among high school students in Makkah, Saudi Arabia. The data reveal that a significant proportion (71.2%, N=89) of students reported using e-cigarettes during the past 30 days. In terms of motivation for current use, the most common reason was influence from family members, with 62.2% (No=56) of students indicating that a family member used e-cigarettes. Peer influence also played a significant role, as 31.1% (No=28) cited friends using e-cigarettes as a reason for their use, while 23.3% (No=21) mentioned curiosity as a factor. As for the types of e-cigarettes used, the most popular choice was e-cigarettes with a refillable tank (50.0%, No=45), followed by disposable e-cigarettes (32.2%, No=29), with a smaller percentage using pod-based e-cigarettes (7.8%, No=7). Remarkably, 10% (No=9) of students were unsure about the type of e-cigarette they used. Considering the brands of e-cigarettes used, the brand Mazag was by far the most commonly used, reported by 82.2% (No=74) of users. Other popular brands included SMOK (including NOVO), used by 45.6% (No=41) of students.

Table 3. E-Cigarette Use Current Patterns Among High School Students in Makkah, Saudi Arabia (N=125)

	No	%
During the past 30 days, did you use e-cigarettes?		
Yes	89	71.2%
No	36	28.8%
Why do you currently use e-cigarettes?		
A family member used them	56	62.2%

A friend used them	28	31.1%
I was curious about them	21	23.3%
To get a high or buzz from nicotine	5	5.6%
They were easier to get than other tobacco products, such as cigarettes	3	3.3%
I could use them unnoticed at home or at school	3	3.3%
I was feeling anxious, stressed, or depressed	3	3.3%
To try to quit using other tobacco products, such as cigarettes	1	1.1%
I've seen people on TV, online, or in movies use them	1	1.1%
They are less harmful than other forms of tobacco, such as cigarettes	1	1.1%

Which of the following best describes the type of e-cigarette you have used in the past 30 days?

A disposable e-cigarette (for example, Puff Bar or STIG)	29	32.2%
An e-cigarette that uses pre-filled or refillable pods or cartridges (for example, JUUL, SMOK, or Suorin)	7	7.8%
An e-cigarette with a tank that you refill with liquids (including mod systems that can be customized by the user)	45	50.0%
I don't know the type	9	10.0%

What e-cigarette brands did you use during the past 30 days?

Mazag	74	82.2%
SMOK (including NOVO)	41	45.6%
Eonsmoke	5	5.6%
blu	4	4.4%
Leap	4	4.4%
Posh	4	4.4%
Oxbar	4	4.4%
Puff Bar	3	3.3%
Logic	2	2.2%
Nasty	2	2.2%
Mojo	1	1.1%

Vuse	1	1.1%
Panther	1	1.1%
Vnsn	1	1.1%
Geek bar	1	1.1%
Not sure / I don't know the brand	7	8.9%

Table 4 presents detailed data on e-cigarette usage patterns among high school students in Makkah, Saudi Arabia. A majority of the students (80%, No=72) reported using Mazag as their usual e-cigarette brand in the past 30 days, indicating that it is the dominant brand among this group. Other brands like blu, Eonsmoke, and Puff Bar were less commonly used, with each accounting for only around 2-2% of the sample. Regarding nicotine content, the vast majority (88.9%, No=80) of students reported that the e-cigarettes they used contained nicotine. When it comes to nicotine salts (nic salts), 35.6% (No=32) of students reported using e-cigarettes containing these compounds, while 58.9% (No=53) were unsure whether their e-cigarettes contained nicotine salts. Flavor preferences were overwhelmingly in favor of fruit flavors, which were used by 93.3% (No=83) of students. Other popular flavors included mint (4.5%, No = 4) and chocolate (3.4%, No=3), while less popular flavors like clove or spice and candy or desserts were used by only a small number of students. When considering how students obtained their e-cigarette products, the majority (67.8%, No=61) reported purchasing their e-cigarettes directly, while smaller percentages obtained them from family members (12.2%, No=11) or friends (8.9%, No=8). Additionally, the most common purchase locations were vaping shops or tobacco shops (68.9%, No=62), followed by gas stations or convenience stores (6.7%, No=6), and a few students reported buying e-cigarettes online or from kiosks.

Table 4. E-Cigarette Brand Preferences, Nicotine Content, Flavors, and Sources of E-Cigarette Purchases Among High School Students in Makkah, Saudi Arabia (N=90)

Items	No	%
During the past 30 days, what brand of e-cigarettes did you usually use?		
Mazag	72	80.0%
Some other brand not listed here (specify):	6	6.7%
blu	2	2.2%
Eonsmoke	2	2.2%
Oxbar	2	2.2%

I did not use a usual brand	1	1.1%
Leap	1	1.1%
Puff Bar	1	1.1%
Nasty	1	1.1%
Geek bar	1	1.1%
Not sure / I don't know the brand	1	1.1%

Did any of the e-cigarettes that you used in the past 30 days contain nicotine?

Yes	80	88.9%
No	2	2.2%
Don't know	8	8.9%

Nicotine salts, or "nic salts", are a type of nicotine that is found in some e-liquids, pods, and cartridges. Did any of the e-cigarettes that you used in the past 30 days contain nicotine salts?

Yes	32	35.6%
No	5	5.6%
Don't know	53	58.9%

Were any of the e-cigarettes that you used in the past 30 days flavored to taste like menthol, mint, clove, or spice, alcoholic drinks, candy, fruit, chocolate, or any other flavor?

Yes	88	97.8%
Don't know	2	2.2%

What flavors were the e-cigarettes that you have used in the past 30 days?

Fruit	83	93.3%
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Mint	4	4.5%
Chocolate	3	3.4%
Clove or spice	2	2.2%
Candy, desserts, or other sweets	2	2.2%
Menthol	1	1.1%

During the past 30 days, how did you get your e-cigarette devices, pods, cartridges, or e-liquid refills?

I bought them myself	61	67.8%
I got them from a family member	11	12.2%
I took them from a store or another person	10	11.1%
I asked someone to give me some	8	8.9%
I got them from a friend	8	8.9%
I had someone else buy them for me	4	4.4%
Someone offered them to me	2	2.2%

During the past 30 days, where did you buy your e-cigarette devices, pods, cartridges, or e-liquid refills?

I did not buy e-cigarettes during the past 30 days	14	15.6%
A vape shop or tobacco shop	62	68.9%
A gas station or convenience store	6	6.7%
I bought them from another person (a friend, family member, or someone else)	5	5.6%
A mall or shopping center kiosk/stand	4	4.4%
On the Internet (such as a product website or store website like eBay or Facebook Marketplace)	3	3.3%
A grocery store	1	1.1%

A vending machine	1	1.1%
Through a delivery service (such as DoorDash or Postmates)	1	1.1%

Table 5 shows the sources and frequency of e-cigarette use among high school students in Makkah. A significant proportion of students (68.9%, N=62) were unsure of the age of the person from whom they obtained the e-cigarette device. However, among those who did know, the majority reported receiving e-cigarettes from individuals younger than 18 years old (16.7%, No=15), followed by a smaller number of students who received them from individuals aged 18 or older (3.3%-4.4%). The data also show that the most common product obtained from others was a new e-cigarette device (93.3%, No=84), while pods, cartridges, or e-liquid refills accounted for only 6.7% (No=6). A smaller percentage (4.4%, No=4) of students reported receiving a hit or drag from someone else's device. Concerning frequency, the majority of students (60%, No=54) reported using someone else's e-cigarette device most of the time in the past 30 days. Smaller proportions indicated rare or occasional use, with 11.1% (No=10) never using someone else's device, and 6.7% (No=6) using it always.

Table 5. Sources and Frequency of Using E-Cigarette Devices Obtained from Others Among High School Students in Makkah, Saudi Arabia (N=90)

Items	No	%
Earlier, you answered that you got or bought your e-cigarette devices, pods, cartridges, or e-liquid refills from another person, such as a friend or family member, during the past 30 days. How old was this person?		
Younger than 18 years old	15	16.7%
18 years old	4	4.4%
19 years old	3	3.3%
20 years old	3	3.3%
21 years old or older	3	3.3%
I don't know	62	68.9%

During the past 30 days, which of the following e-cigarette products (s) did you get or buy from another person?		
A new e-cigarette device (including disposable devices)	84	93.3%
A pod, cartridge, or e-liquid refill	6	6.7%
A hit or a drag from another person's e-cigarette device	4	4.4%
During the past 30 days, how often did you use someone else's e-cigarette device?		
Never	10	11.1%
Rarely	13	14.4%
Sometimes	7	7.8%
Most of the Time	54	60.0%
Always	6	6.7%

Table 6 presents data on the intentions and efforts of high school students to quit using e-cigarettes. The results indicate a mixed approach to quitting among e-cigarette users, with the majority (56.2%, No=50) not planning to quit within the next 12 months. However, a substantial proportion of students (13.5%, No=12) are seriously considering quitting within the next 30 days, and 15.7% (No=14) are planning to quit within the next 12 months. When asked about previous attempts to quit, the majority (62.9%, No=56) reported having tried to quit 2 times in the past 12 months. A smaller number reported trying to quit once (11.2%, No=10) or multiple times (6.7%, No=6), with a few students (1.1%, No=1) attempting to quit 6 to 9 times or 10 or more times (9%, No=8). In terms of the resources used to quit, a significant number of students (55.4%, N=46) relied on help or advice from a friend or peer, which points to the importance of peer support in cessation efforts. However, a considerable portion (33.7%, No=28) reported not using any resources at all when trying to quit. Very few students turned to professional or digital support systems, with only 4.8% (No=4) seeking advice from parents or caregivers, and 2.4% (No=2) using resources like teachers, coaches, internet advice, or mobile apps.

Table 6. Intentions and Attempts to Quit E-Cigarettes Among High School Students in Makkah, Saudi Arabia (N=90)

Items	No	%
Are you seriously thinking about quitting e-cigarettes?		
Yes, during the next 30 days	12	13.5%
Yes, during the next 6 months	3	3.4%
Yes, during the next 12 months	14	15.7%
Yes, but not during the next 12 months	50	56.2%
No, I am not thinking about quitting e-cigarettes	10	11.2%
During the past 12 months, how many times have you stopped using e-cigarettes for one day or longer because you were trying to quit using e-cigarettes for good?		
I did not try to quit during the past 12 months	8	9.0%
1 time	10	11.2%
2 times	56	62.9%
3 to 5 times	6	6.7%
6 to 9 times	1	1.1%
10 or more times	8	9.0%
When you tried to quit using e-cigarettes, did you use any of the following?		
I did not use any resources	28	33.7%
Help or advice from a friend or peer	46	55.4%
Help or advice from a parent or caregiver	4	4.8%
Help or advice from a teacher or coach	2	2.4%

Help or advice you found on the Internet	2	2.4%
A mobile app or texting program	2	2.4%
A telephone helpline or Quitline	1	1.2%

Table 7 clarifies the curiosity and future intentions regarding e-cigarette use among non-user high school students in Makkah, Saudi Arabia. The vast majority of students (65.7%, No=228) report that they have never been curious about using an e-cigarette, and a substantial proportion (87.9%, No=305) express that they are definitely not likely to use an e-cigarette in the next year. Furthermore, when asked whether they would use an e-cigarette if offered by a best friend, a large majority (88.2%, No=306) stated that they would definitely not use one. However, a small percentage of students expressed curiosity or potential openness to trying e-cigarettes. For instance, 8.1% (No=28) of students admitted to being curious about using an e-cigarette, and 15.9% (No=55) said they would probably try one. Despite this, the number of students who expressed an intention to try an e-cigarette soon or in the next year remained extremely low, with only 5.5% (No=19) of students indicating they were likely to use an e-cigarette soon.

Table 7. Curiosity and Future Intentions Regarding E-Cigarette Use Among Non-users High School Students in Makkah, Saudi Arabia (N=347)

Items	No	%
Have you ever been curious about using an e-cigarette?		
Definitely yes	28	8.1%
Probably yes	55	15.9%
Probably not	36	10.4%
Definitely not	228	65.7%
Do you think that you will try an e-cigarette soon?		
Definitely yes	2	.6%
Probably yes	17	4.9%

Probably not	30	8.6%
Definitely not	298	85.9%
Do you think you will use an e-cigarette in the next year?		
Definitely yes	3	.9%
Probably yes	11	3.2%
Probably not	28	8.1%
Definitely not	305	87.9%
If one of your best friends were to offer you an e-cigarette, would you use it?		
Definitely yes	4	1.2%
Probably yes	15	4.3%
Probably not	22	6.3%
Definitely not	306	88.2%

Table 8 examines factors associated with e-cigarette use among high school students in Makkah. The age of the students was significantly associated with e-cigarette use ($p = 0.003$), with higher percentages of use observed among older students. Exactly 33.1% of 17-year-olds and 32.6% of students aged 18-19 reported ever using e-cigarettes, compared to just 10.3% of 13-15-year-olds. The gender of participants was also a significant factor ($p = 0.004$). A larger proportion of female students (33.5%) reported using e-cigarettes at least once, compared to male students (21.8%). Another significant factor was the amount of money spent per week ($p = 0.0001$). Among students who spent more than 100 SR per week, nearly half (49.6%) reported having ever used an e-cigarette. Additionally, family smoking status showed strong associations with e-cigarette use. Students whose fathers smoked (48.8%) or whose mothers smoked (77.3%) were significantly more likely to have used e-cigarettes compared to those whose parents did not smoke. Lastly, family income was found to be a significant factor ($p = 0.001$). Among students from families with incomes higher than 20,000 riyals, 47.7% reported e-cigarette use, compared to only 23.2% of those from families with incomes below 10,000 riyals.

Table 8. Factors associated with E-cigarette use among High School Students in Makkah

Factors		Have you ever used an e-cigarette, even once or twice?				p-value
		Yes		No		
		N	%	No	%	
Age in years	13-15	6	10.3%	52	89.7%	.003*
	16	36	23.4%	118	76.6%	
	17	56	33.1%	113	66.9%	
	18-19	31	32.6%	64	67.4%	
Gender of participants	Male	57	21.8%	204	78.2%	.004*
	Female	72	33.5%	143	66.5%	
Grade of participants	10th grade	31	26.1%	88	73.9%	.760
	11th grade	43	25.7%	124	74.3%	
	12th grade	55	28.9%	135	71.1%	
Chronic disease of participants	Diabetes	1	20.0%	4	80.0%	.491^
	Heart Diseases	0	0.0%	6	100.0%	
	Asthma	8	26.7%	22	73.3%	
	Medically free	120	27.6%	315	72.4%	
Participants who have ever been diagnosed with a mental illness	Yes	5	31.3%	11	68.8%	.704^
	No	124	27.0%	336	73.0%	
Participants who have ever experienced domestic violence	Yes	6	27.3%	16	72.7%	.985
	No	123	27.1%	331	72.9%	
Exercise regularly	Yes	26	28.3%	66	71.7%	.951
	Some times	81	26.6%	223	73.4%	
	No	22	27.5%	58	72.5%	
Amount of money spent per week	Don't spent	5	12.5%	35	87.5%	.0001*
	< 10 SR	11	29.7%	26	70.3%	
	10-30 SR	22	21.2%	82	78.8%	

	30-50 SR	23	22.5%	79	77.5%	
	50-100 SR	12	15.0%	68	85.0%	
	> 100 SR	56	49.6%	57	50.4%	
Father's level of education	Illiterate	2	28.6%	5	71.4%	.943
	Primary school	3	25.0%	9	75.0%	
	Secondary school	7	30.4%	16	69.6%	
	High school	26	27.7%	68	72.3%	
	Diploma	10	27.8%	26	72.2%	
	Bachelor	58	29.3%	140	70.7%	
	Higher education	11	20.8%	42	79.2%	
	I don't know	12	22.6%	41	77.4%	
Mother's level of education	Illiterate	2	28.6%	5	71.4%	.187
	Primary school	5	35.7%	9	64.3%	
	Secondary school	14	37.8%	23	62.2%	
	High school	19	19.4%	79	80.6%	
	Diploma	11	25.6%	32	74.4%	
	Bachelor	58	32.0%	123	68.0%	
	Higher education	8	23.5%	26	76.5%	
	I don't know	12	19.4%	50	80.6%	
Parents' occupational status	Father working	59	23.4%	193	76.6%	.276 ^
	Mother working	4	30.8%	9	69.2%	
	Both father and mother) working	49	33.6%	97	66.4%	
	Both (father and mother) not working	13	25.0%	39	75.0%	
	I don't know	4	30.8%	9	69.2%	
Family income	Less than 10000 riyals	16	23.2%	53	76.8%	.001
	From 10000-20000 riyals	29	23.4%	95	76.6%	*

	More than 20000 riyals	51	47.7%	56	52.3%	
	I don't know	33	18.8%	143	81.3%	
Father smoking status: (in any form)	Yes	61	48.8%	64	51.2%	.001
	No	68	19.4%	283	80.6%	*
Mother smoking status: (in any form)	Yes	34	77.3%	10	22.7%	.001
	No	95	22.0%	337	78.0%	*

P: Pearson X^2 test; $\wedge$: Exact probability test; * $P < 0.05$ (significant)

The multiple logistic regression analysis identified several significant predictors of e-cigarette use among high school students in Makkah. Age was found to be a significant factor, with older students (ages 16 and above) being more likely to use e-cigarettes. The odds of e-cigarette use increased by 1.74 times for each year of age ($p = 0.001$). Additionally, students in higher grades (11th and 12th) were more likely to use e-cigarettes compared to those in lower grades, with an odds ratio of 1.62 ($p = 0.025$). Money spent per week also played a significant role, with students who spent more money every week being more likely to use e-cigarettes. Specifically, for each additional unit of weekly spending, the odds of e-cigarette use increased by 19% ($ORA = 1.19$, $p = 0.029$). Furthermore, parental smoking habits were strongly associated with students' e-cigarette use. Students whose fathers smoked in any form had 2.46 times higher odds of using e-cigarettes ($p = 0.001$), while students whose mothers smoked had even stronger associations, with an odds ratio of 8.00 ($p = 0.001$). Other factors, such as gender, chronic disease, mental illness, domestic violence, exercise habits, family income, and parental education levels, did not show significant associations with e-cigarette use in this analysis.

Table 9. Multiple Logistic Regression for Predictors of E-Cigarette Use Among High School Students in Makkah

Predictors	p-value	OR _A	95% CI	
			Lower	Upper
Age in years	.001*	1.74	1.24	2.43
Female gender	.082	1.53	0.95	2.47
Higher grades	.025*	1.62	1.06	2.47
Have a chronic disease	.345	0.76	0.42	1.35

Mental illness	.939	1.05	0.27	4.07
Domestic violence	.862	1.10	0.36	3.40
Exercise regularly	.798	1.05	0.71	1.55
Money spent per week	.029*	1.19	1.02	1.40
Father's level of education	.772	0.97	0.81	1.17
Mother's level of education	.477	0.94	0.79	1.12
Working parents	.377	1.09	0.90	1.32
Family income	.716	1.04	0.84	1.30
Father's smoking status in any form	.001*	2.46	1.49	4.08
Mother's smoking status in any form	.001*	8.00	3.53	18.16

*OR_A: Adjusted odds ratio; CI: Confidence interval; *P < 0.05 (significant)*

DISCUSSION

The results of this study show that there is a high prevalence of e-cigarette smoking among high school students in Makkah, Saudi Arabia. This puts another stress on public healthcare, which is already a concern because, though e-cigarettes are considered to be less hazardous than traditional cigarettes, there is a mounting body of research suggesting their harms. This study's results are in line with international trends, and they also show distinctive local aspects concerning e-cigarette smoking among Saudi teenagers.

The reported lifetime prevalence rate of e-cigarette usage of 27.1% seems to be more than what was reported in Saudi Arabia, but is certainly in line with increasing global figures. For example, Qanash et al. [1] reported a 12.8% prevalence among health science students in Saudi Arabia, while Habib et al. [13] reported 12.2% usage among healthcare providers in Makkah. The increased usage prevalence in our study could be due to greater marketing and availability of e-cigarettes to younger populations, as well as their peers normalizing vaping. Other parts of the world also report similar studies; however, the global prevalence rates vary. For instance, the 2022 NYTS in the United States reports e-cigarette smoking prevalence rate among high school students aged 14 to 18 to be 14.1% [14]. Meanwhile, Jiang et al. [2] reported the figure to be 7.2% in Hong Kong, while Poland recorded it as 29.3% among rural adolescents, which is close to our finding [9]. The explanations for these growing concerning rates in Poland and along with our study

could be linked to relatively permissive cultural stance surrounding its use, along with lacking regulations, aggressive e-cigarette advertising, and increased focus on vape, which increases adolescent vaping in some regions.

In some Asian countries, cultural acceptance is shaped by friends and parents, with peers serving as the primary procurers of e-cigarettes [15,16]. Vaping products are more easily available to adolescents due to lax regulations, inadequate enforcement of age barriers, and other forms of supervision [15]. This is indicated by the fact that countries with stricter regulations, like Thailand, Korea, India, and Vietnam, have lower rates of adolescent vaping [16,17]. Furthermore, e-cigarette marketers target young consumers using bold marketing strategies that include sweet flavored e-liquids, vibrant packaging, and youth-appealing designs [18]. This is similar to countries like Indonesia and Malaysia, where the rise of e-commerce paired with weak regulations has led to rampant online advertising targeted at youth and easier access to the products for adolescents [15].

This study showed that older students (17–19 years) were e-cigarette users to a greater extent than their younger counterparts, with 10.3% among 13–15 years vs. 32.6% among 18–19 years. This aligns with the developmental theories which posit that risk-taking behavior tends to be more prominent during late adolescence [19]. Similar patterns were noted in the UK, where Brown et al. [10] found that 16–18 year olds were twice as likely to vape compared to 11–15 year olds. There was also a notable difference in e-cigarette usage among students, with female students being the most affected at 33.5% as compared to male respondents at 21.8%. This contradicts global trends where the male population tends to overpower the tobacco and e-cigarette consumption sphere [20]. However, evidence shows an emerging shift that younger females are increasingly taking up vaping under the influence of social media viewing e-cigarettes as “safer” and more socially acceptable compared to traditional smoking [21–24].

We found a strong association between parental smoking and adolescent e-cigarette use. Students with smoking fathers were 2.46 times more likely to vape, while those with smoking mothers had an 8-fold increased risk. These findings align with Leventhal et al. [3], who argued that parental smoking is a significant determinant for adolescent e-cigarette uptake. This might be reflective of stronger effects of maternal smoking that underscore the closeness of the mother-children bond in Saudi culture, since mothers tend to do more of the active supervision of daily activities in comparison to fathers. Also, family income was a factor where a greater proportion of wealthier students (47.7% in SR 20,000 households) used e-cigarettes than their lower-income peers (23.2%). This is contrary to Western studies in which lower socioeconomic status (SES) is frequently associated with a greater use of tobacco [25,26]. In Saudi Arabia, however, disposable income might allow access to expensive e-cigarette devices that are often advertised as luxury goods [27]. Aligning with global youth preferences [28,29], this study shows that fruit-flavored e-cigarettes are the most popular (93.3%). Unlike the U.S., where JUUL and Puff Bar dominate the market, the Mazag brand (82.2%) was the most preferred,

indicating the growing influence of local markets in Saudi Arabia. The high nicotine content (88.9%) and use of nicotine salts (35.6%) suggest that the addiction potential is high, agreeing with findings that nicotine salts enhance absorption and appeal [31]. A worrying finding is that 41.9% of users report purchasing e-cigarettes on school grounds, which suggests poor enforcement of age restrictions. This is different from U.S. data, which shows a greater prevalence of buying items through online payments [32]. The dominance of vape shops (68.9%) suggests that local merchants do not strongly enforce age restrictions for purchasing, which is also reported in Malaysia and other countries [33,34]. Even though attempting to quit was reported by 62.9% of users, most leaned on friends for aid (55.4%) instead of receiving professional assistance. This is consistent with global patterns among youths, where stigma and lack of youth-friendly cessation programs hinder quitting [35]. Using digital programs to assist was reported by only 2.4%, which is different from Western programs, where the “Quit Vaping” App has proven productive [36,37].

The results of the research highlight the persistent gap needing attention in terms of parenting policies for controlling the growing worrying trend of e-cigarette consumption among high school students in Makkah. First, restrictions on age verification need to be enforced, including the prohibition of selling e-cigarettes in the vicinity of school boundaries and identification checks at the sale outlets like those required by the U.S. Food and Drug Administration (FDA) [38]. Moreover, the prohibition of e-cigarette products with particularly enticing and sugary fruit and candy flavors that appeal to the youth needs to be banned to help reduce the initiation rates. This policy is in line with some national and regional regulatory measures taken in the European Union and several states in the U.S. and has yielded promising results [39]. Prevention, too, must be a priority for schools. Including e-cigarette prevention education in the classroom and supporting student-led cessation programs equips students with relevant information and helps them quit or abstain from using these devices. In addition, the influence of parents is critical, so they need to be the subject of public health campaigns and informed about the dangers of using e-cigarettes and how such behavior negatively impacts their children. Finally, increasing the taxation of e-cigarettes could limit the availability and affordability of these products for young people, something already accomplished in Australia.

CONCLUSION

This study highlights a concerning high prevalence of e-cigarette use among secondary school students in Makkah, Saudi Arabia, and the relative ease of access, peer usage, and parental smoking seem to be primary drivers. Access to fruit-flavored e-cigarettes containing high doses of nicotine puts young people at risk of addiction and illustrates a blatant lack of regulatory oversight. While our

results align with some international studies (e.g., increase in use with age), there are notable local differences (e.g., more prevalent use among females). More robust enforcement of age restrictions, flavored e-cigarette bans, and school-based education campaigns are all necessary. Stronger policies aimed at reducing parental smoking and increasing access to cessation services are essential in lowering youth vaping. Further studies should investigate the impacts on long-term health and focus on culture-specific strategies to reduce this looming concern in public health.

REFERENCES

1. Qanash S, Alemam S, Mahdi E, Softah J, Touman A, Alsulami A: Electronic cigarette among health science students in Saudi Arabia. *Ann Thorac Med*. 2019, 14:56. 10.4103/atm.ATM_76_18
2. Jiang N, Wang MP, Ho SY, Leung LT, Lam TH: Electronic cigarette use among adolescents: a cross-sectional study in Hong Kong. *BMC Public Health*. 2016, 16:202. 10.1186/s12889-016-2719-4
3. Leventhal AM, Strong DR, Kirkpatrick MG, et al.: Association of Electronic Cigarette Use With Initiation of Combustible Tobacco Product Smoking in Early Adolescence. *JAMA*. 2015, 314:700. 10.1001/jama.2015.8950
4. Barrington-Trimis JL, Urman R, Berhane K, et al.: E-Cigarettes and Future Cigarette Use. *Pediatrics*. 2016, 138:e20160379. 10.1542/peds.2016-0379
5. Al-Turki YA: Smoking habits among medical students in Central Saudi Arabia. *Saudi Med J*. 2006, 27:700–3.
6. Wali SO: Smoking habits among medical students in Western Saudi Arabia. *Saudi Med J*. 2011, 32:843–8.
7. Azhar A, Alsayed N: Prevalence of Smoking among Female Medical Students in Saudi Arabia. *Asian Pac J Cancer Prev*. 2012, 13:4245–8. 10.7314/APJCP.2012.13.9.4245
8. Andrade MD, Hastings G, Angus K: Promotion of electronic cigarettes: tobacco marketing reinvented? *BMJ*. 2013, 347:f7473–f7473. 10.1136/bmj.f7473
9. Kaleta D, Wojtysiak P, Polańska K: Use of electronic cigarettes among secondary and high school students from a socially disadvantaged rural area in Poland. *BMC Public Health*. 2016, 16:703. 10.1186/s12889-016-3417-y

- 333 10. Brown J, West R, Beard E, Michie S, Shahab L, McNeill A: Prevalence and characteristics of e-cigarette users in Great Britain:
334 Findings from a general population survey of smokers. *Addict Behav.* 2014, 39:1120–5. 10.1016/j.addbeh.2014.03.009
- 335 11. Nargis N: Healthy People Countdown 2030: reaching 5% cigarette smoking prevalence among U.S. adults through state cigarette
336 excise tax increases. *Tob Control.* 2023, 32:388–92. 10.1136/tobaccocontrol-2021-056755
- 337 12. Parns TA, Valverde R, Park-Lee E, Graham-Glover BS, Cunningham CS, Sawdey MD, Cullen KA: Symptoms of tobacco
338 dependence among middle and high school tobacco users – Data from the 2019–2020 National Youth Tobacco Survey. *Addict*
339 *Behav.* 2023, 137:107537. 10.1016/j.addbeh.2022.107537
- 340 13. Habib E, Helaly M, Elshaer A, Sriwi D, Ahmad MS, Mohamed MI, Obeidat A: Prevalence and perceptions of e-cigarette use
341 among medical students in a Saudi University. *J Fam Med Prim Care.* 2020, 9:3070–5. 10.4103/jfmprc.jfmprc_235_20
- 342 14. Cooper M, Park-Lee E, Ren C, Cornelius M, Jamal A, Cullen KA: Notes from the Field: E-cigarette Use Among Middle and High
343 School Students — United States, 2022. *MMWR Morb Mortal Wkly Rep.* 2022, 71:1283–5. 10.15585/mmwr.mm7140a3
- 344 15. Ko K, Ting Wai Chu J, Bullen C: A Scoping Review of Vaping Among the Asian Adolescent Population. *Asia Pac J Public*
345 *Health.* 2024, 36:664–75. 10.1177/10105395241275226
- 346 16. Gravely S, Driezen P, Ouimet J, et al.: Prevalence of awareness, ever-use and current use of nicotine vaping products (NVPs)
347 among adult current smokers and ex-smokers in 14 countries with differing regulations on sales and marketing of NVPs:
348 cross-sectional findings from the ITC Project. *Addiction.* 2019, 114:1060–73. 10.1111/add.14558
- 349 17. Jane Ling MY, Abdul Halim AFN, Ahmad D, Ahmad N, Safian N, Mohammed Nawi A: Prevalence and Associated Factors of E-
350 Cigarette Use among Adolescents in Southeast Asia: A Systematic Review. *Int J Environ Res Public Health.* 2023, 20:3883.
351 10.3390/ijerph20053883
- 352 18. Adekeye OT, Boltz M, Jao Y-L, Branstetter S, Exten C: Vaping in the Digital Age: How Social Media Influences Adolescent
353 Attitudes and Beliefs About E-Cigarette Use. *J Child Adolesc Subst Use.* 2025, 30:13–26. 10.1080/1067828X.2024.2439599
- 354 19. Steinberg L: A social neuroscience perspective on adolescent risk-taking. *Dev Rev.* 2008, 28:78–106. 10.1016/j.dr.2007.08.002
- 355 20. Wang M, Wang J-W, Cao S-S, Wang H-Q, Hu R-Y: Cigarette Smoking and Electronic Cigarettes Use: A Meta-Analysis. *Int J*
356 *Environ Res Public Health.* 2016, 13:120. 10.3390/ijerph13010120

- 357 21. Wang T-CL, Zhang M-J, Zhang H: Examining the impact of social media on youth vaping behavior in China: an analysis of the
358 mediating role of perceptions of policy enforcement. *Front Public Health*. 2025, 13:1524524. 10.3389/fpubh.2025.1524524
- 359 22. Katz SJ, Erkinen M, Lindgren B, Hatsukami D: Beliefs about E-cigarettes: A Focus Group Study with College Students. *Am J*
360 *Health Behav*. 2019, 43:76–87. 10.5993/AJHB.43.1.7
- 361 23. Dar-Odeh N, Abu-Hammad O: Tobacco Use by Arab Women. In: Laher I, ed. *Handbook of Healthcare in the Arab World*.
362 Springer International Publishing: Cham; 2020. 1–27.10.1007/978-3-319-74365-3_10-1
- 363 24. Hams A Mohamed Saeed, Abdel Hamid Ms Esmail: Understanding vaping among female students in Saudi Arabia: Prevalence,
364 causes, and student-suggested interventions. *World J Biol Pharm Health Sci*. 2025, 21:479–479. 10.30574/wjbphs.2025.21.3.0295
- 365 25. Pampel FC, Krueger PM, Denney JT: Socioeconomic Disparities in Health Behaviors. *Annu Rev Sociol*. 2010, 36:349–70.
366 10.1146/annurev.soc.012809.102529
- 367 26. Hitchman SC, Fong GT, Zanna MP, Thrasher JF, Chung-Hall J, Siahpush M: Socioeconomic status and smokers' number of
368 smoking friends: Findings from the International Tobacco Control (ITC) Four Country Survey. *Drug Alcohol Depend*. 2014,
369 143:158–66. 10.1016/j.drugalcdep.2014.07.019
- 370 27. Alzahrani T, Alhazmi MF, Alharbi AN, AlAhmadi FT, Alhubayshi AN, Alzahrani BA: The Prevalence of Electronic Cigarette
371 Use Among College Students of Taibah University and Symptoms of Cardiovascular Disease. *J Saudi Heart Assoc*. 2023, 35:163–
372 8. 10.37616/2212-5043.1338
- 373 28. Gaiha SM, Lempert LK, McKelvey K, Halpern-Felsher B: E-cigarette devices, brands, and flavors attract youth: Informing FDA's
374 policies and priorities to close critical gaps. *Addict Behav*. 2022, 126:107179. 10.1016/j.addbeh.2021.107179
- 375 29. Groom AL, Vu T-HT, Kesh A, et al.: Correlates of youth vaping flavor preferences. *Prev Med Rep*. 2020, 18:101094.
376 10.1016/j.pmedr.2020.101094
- 377 30. Dai H, Hao J: Online popularity of JUUL and Puff Bars in the USA: 2019–2020. *Tob Control*. 2022, 31:7–10.
378 10.1136/tobaccocontrol-2020-055727
- 379 31. Harrell PT, Simmons VN, Correa JB, Padhya TA, Brandon TH: Electronic Nicotine Delivery Systems (“E-cigarettes”): Review of
380 Safety and Smoking Cessation Efficacy. *Otolaryngol Neck Surg*. 2014, 151:381–93. 10.1177/0194599814536847

- 381 32. King BA, Gammon DG, Marynak KL, Rogers T: Electronic Cigarette Sales in the United States, 2013-2017. JAMA. 2018,
382 320:1379. 10.1001/jama.2018.10488
- 383 33. Williams RS, Derrick J, Liebman AK, LaFleur K, Ribisl KM: Content analysis of age verification, purchase and delivery methods
384 of internet e-cigarette vendors, 2013 and 2014. Tob Control. 2018, 27:287–93. 10.1136/tobaccocontrol-2016-053616
- 385 34. Cooray M: LEGAL CHALLENGES OF ADOPTING AGE-VERIFICATION TECHNIQUES FOR THE PROTECTION OF
386 MINORS ON THE INTERNET IN MALAYSIA. Int J Law Gov Commun. 2020, 5:80–6. 10.35631/IJLGC.520005
- 387 35. Amato MS, Bottcher MM, Cha S, Jacobs MA, Pearson JL, Graham AL: “It’s really addictive and I’m trapped:” A qualitative
388 analysis of the reasons for quitting vaping among treatment-seeking young people. Addict Behav. 2021, 112:106599.
389 10.1016/j.addbeh.2020.106599
- 390 36. Sanchez S, Kundu A, Limanto E, Selby P, Baskerville NB, Chaiton M: Smartphone Apps for Vaping Cessation: Quality
391 Assessment and Content Analysis. JMIR MHealth UHealth. 2022, 10:e31309. 10.2196/31309
- 392 37. Palmer AM, Tomko RL, Squeglia LM, et al.: A pilot feasibility study of a behavioral intervention for nicotine vaping cessation
393 among young adults delivered via telehealth. Drug Alcohol Depend. 2022, 232:109311. 10.1016/j.drugalcdep.2022.109311
- 394 38. FDA: Family Smoking Prevention and Tobacco Control Act - An Overview. (2009). Accessed: May 5, 2025.
395 [https://www.fda.gov/tobacco-products/rules-regulations-and-guidance-related-tobacco-products/family-smoking-prevention-and-](https://www.fda.gov/tobacco-products/rules-regulations-and-guidance-related-tobacco-products/family-smoking-prevention-and-tobacco-control-act-overview)
396 [tobacco-control-act-overview](https://www.fda.gov/tobacco-products/rules-regulations-and-guidance-related-tobacco-products/family-smoking-prevention-and-tobacco-control-act-overview).
- 397 39. Reiter A, Hébert-Losier A, Mylocopos G, et al.: Regulatory Strategies for Preventing and Reducing Nicotine Vaping Among
398 Youth: A Systematic Review. Am J Prev Med. 2024, 66:169–81. 10.1016/j.amepre.2023.08.002
- 399