

Impact of Electronic Cigarette Smoking on the Saudi Population: A Systematic Review

Turki Fahad Alsabhan¹, Khaled F. Alrimali^{2*}

¹Instructor in the Saudi Electronic University, College of Health Science, Public Health Department, Hail, Saudi Arabia, Email: t.alsabhan@seu.edu.sa

²Instructor in the Saudi Electronic University, College of Health Science, Public Health Department, Hail, Saudi Arabia, Email: k.alrimali@seu.edu.sa

*Corresponding Author

Received: 17.09.2024

Revised: 14.10.2024

Accepted: 05.11.2024

ABSTRACT

Objectives: This study is a comprehensive review and analysis of literature to investigate the patterns and attitudes surrounding e-cigarette use among the Saudi population over a period of six years.

Review methods: A comprehensive search was conducted on Medline, PubMed, CINHIL, and ScienceDirect using the following alternate terms for e-cigarettes: electronic cigarettes, electronic nicotine delivery systems. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram guided the inclusion of the studies published from 2018 to 2024.

Results: Six studies were found fit to be included in this review, revealing the impacts and determinants of the usage and attitudes toward e-cigarette smoking among the Saudi population. The usage of e-cigarettes was high among the Saudi population and a wide variety of reasons were recorded for the use of e-cigarettes. Amongst these, lower costs, peer influence, curiosity, quitting traditional smoking, stress relief, flavor enjoyment were the significant factors identified.

Conclusion: The findings underscore the significance of recognizing the harmful impacts of smoking and usage of other/ any type of tobacco, the roles of public health systems and health policy are critical to eliminate smoking and control the aggressive e-cigarettes marketing.

Key words: E-Cigarettes, smoking, Saudi Arabia, Saudi Population.

Background

Electronic cigarettes (e-cigarettes) emerged in the mid-20th century, with the initial patent granted in 1965. Positioned as a safer alternative to traditional cigarettes, e-cigarettes gained traction in the early 21st century, particularly in the United States and China (1-2). Aggressive marketing campaigns transformed e-cigarettes from a niche product to a mainstream consumer item (3). These battery-powered devices were designed to deliver nicotine through vapor inhalation introduced by Chinese pharmacist Hon Lik in 2003. While initially promoted as a smoking cessation aid, growing concerns have emerged regarding the potential health risks associated with e-cigarette use (4). These devices do deliver nicotine, a highly addictive substance, and the aerosol produced contains a range of harmful chemicals, including heavy metals and volatile organic compounds (5). Exposure to these substances has been linked to various health issues, including respiratory problems, cardiovascular disease, and reproductive harm (5-6). Furthermore, the addictive nature of nicotine, particularly among young people, has become a significant public health concern (5-6). The role of e-cigarettes as a potential gateway to traditional cigarette smoking also warrants attention (6).

Globally, the consumption of tobacco products is prevalent, with manufacturers employing sophisticated marketing strategies to promote these items through appealing advertisements (7). This trend spans various demographic groups, including youth, adults, and the elderly, with young people being particularly susceptible to tobacco use (8). The World Health Organization (WHO) recognizes the tobacco epidemic as one of the most significant threats to public health, attributing over seven million fatalities each year to tobacco-related illnesses (9). Among these, approximately six million deaths are directly linked to tobacco use, while around 890,000 non-smokers die from exposure to secondhand smoke (9-10). The economic repercussions of tobacco consumption are also profound, as premature deaths not only deprive families of income, but also, impose substantial costs on healthcare systems (11).

In Saudi Arabia, excessive tobacco use adversely affects both public health and economic progress, leading to the deaths of more than 7,000 individuals annually due to smoking-related diseases (12). There remains an alarming number of current users, including approximately 20,000 children aged 10 to 14 and about 3.35 million adults over the age of 15 (13). The estimated economic burden of tobacco use in Saudi Arabia is around 4.5 billion riyals, which encompasses both direct healthcare expenditures and indirect costs related to lost productivity resulting from premature mortality and morbidity (13-14).

There is a documented increase in the prevalence of e-cigarette usage globally (5-6-10). Given their growing popularity, e-cigarettes pose public health concerns due to the aerosols they use, which may contain various harmful substances. Common compounds found in e-cigarette aerosols include propylene glycol, glycerin, toxic metals (such as lead, cadmium, and nickel), and other carcinogenic carbonyl compounds like formaldehyde (15). These substances may compromise DNA integrity, hindering its capacity for repair during replication, and contribute to respiratory illnesses (15). Nicotine, a key ingredient in e-cigarettes, poses specific risks, particularly for developing adolescents and pregnant women, with long-term exposure linked to attention deficits, mood disorders, and cognitive impairments (15).

Additionally, nicotine has been found to diminish insulin sensitivity across all age groups, potentially leading to insulin resistance and type II diabetes (15-16). Modern e-cigarette devices, equipped with larger batteries, can heat e-liquids to higher temperatures (11). This enhancement may result in greater nicotine release, the intake of additional toxicants, and the generation of larger clouds of particulate matter (9). A notable aspect of these newer devices is the significantly higher levels of formaldehyde produced, a known carcinogen, raising concerns about user tolerance to the aerosol's taste at elevated temperatures (4).

Given the potential health effects of e-cigarettes, there is a pressing need to address these issues, particularly in Saudi Arabia, where e-cigarette use is prevalent and marketing strategies frequently target youth. To the best of our knowledge, there are currently no clinical reports or randomized trials in the literature that examine the health implications of e-cigarette use within the Saudi population.

Objective

The objective of this systematic review is to analyze the prevalence and attitudes towards e-cigarette usage among the Saudi population by examining relevant literature.

Search strategy

A systematic literature search was conducted to identify relevant studies on e-cigarette use among the Saudi population. The search adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Electronic databases including PubMed, Google Scholar, Web of Science, Scopus, Medline, Cochrane, and Saudi Digital Library were systematically searched using a combination of keywords related to e-cigarettes, smoking, and the Saudi population. The search was limited to articles published between January 2018 and December 2024.

An initial screening process involved a thorough examination of article titles and abstracts to eliminate irrelevant studies. Subsequently, a detailed assessment of the full text of selected articles was conducted to determine eligibility based on predefined inclusion criteria cited below.

Eligibility criteria

Inclusion criteria

The inclusion criteria was limited to cross-sectional observational studies that were published within the timeframe of 2018 to 2024 and had reported the prevalence and attitudes towards e-cigarette usage among the Saudi population by examining relevant literature were included.

Exclusion criteria

Unpublished papers uploaded online, articles where the full text was not available, case reports, review articles, and articles that were not in the English language were excluded.

Identification of the literature

Findings from the electronic searches based on the selection criteria resulted in (n =6) papers that were included in this systematic review as illustrated in figure 1. The studies that met inclusion criteria were screened for eligibility and relevance based on titles and abstracts (17-18-19-20-21-22). In instances where the title/abstract did not yield the needed information or conclusive decision, a comprehensive assessment of the full articles was performed. After the full-text screening, papers not meeting the inclusion criteria were systematically removed. Any discrepancies in the selection process were thoughtfully resolved through discussion to reach an agreement. In total, 48 articles were yielded from the initial database search, of which 5 articles were excluded for duplication. Following the review of their titles and abstracts, 19 irrelevant articles were further excluded.

Among the 24 articles assessed for eligibility, 18 articles were excluded for not fitting the inclusion criteria. Finally, the total number of articles included in the current systematic review is 6.

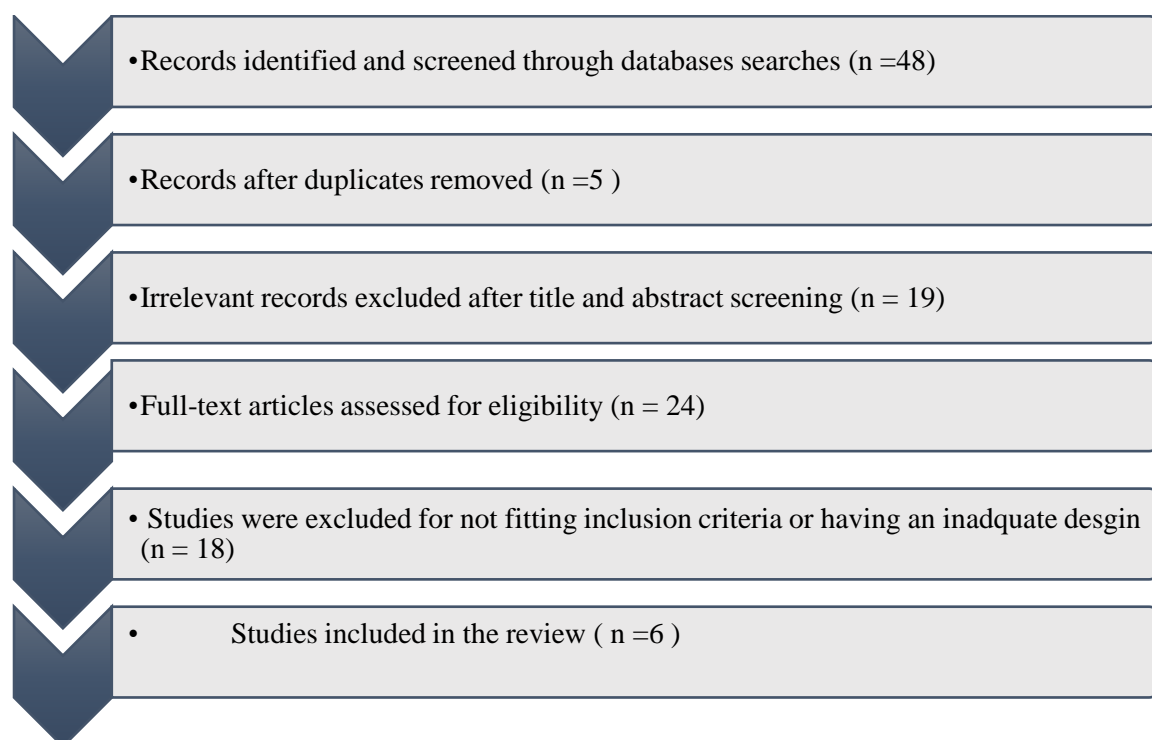


Figure 1: Study selection flow chart

Data synthesis

The studies selected for this systematic review were conducted in western and eastern regions (17-18-19-20-21-22) of Saudi Arabia. The selected six studies used a self-reporting questionnaire to collect data from the study participants through direct approach, online forums and survey panels, both physical and online (17-18-19-20-21-22).

Among the studies which were included in this systematic review, two studies were conducted at Saudi universities and two other studies were conducted in the eastern region; one was on male smokers and the other on female smokers, exclusively. The remaining two studies were conducted on adult smokers in the eastern region and across the country. The participants' demographic characteristics (age, nationality, gender, smoking status) varied among the selected studies. Among the selected six studies, two were conducted on university students, and of these, one among females.

The primary focus of this review was to analyze the prevalence and attitudes towards e-cigarette usage among the Saudi population.

These studies as illustrated in table 1 reported that participants used e-cigarettes for a variety of reasons; the most commonly reported reason was using it as a fashionable, alternative, smoking method. The second reported reason for using e-cigarettes was for quitting traditional smoking. The third reported reason for using e-cigarettes was friends and family influence. Other reasons reported for using e-cigarettes were the depression alleviation and stress relief.

Table 1. Salient features of the studies included in this review

Study	Methods	Participants & Prevalence	Findings
Alzahrani et al. (2021) Electronic cigarettes consumption and associated factors among general population in Western Saudi Arabia	An observational cross-sectional study, data were collected from 465, 18 years or older smokers during a survey at public attractions.	40.7% had resorted to conventional smoking such as cigarette, shisha, hookah in the last thirty days. 35% were never consumed conventional smoking in the last thirty days.	49.4% used e-cigarette to cease traditional smoking via e-cigarette. 33.9% used e-cigarette for entertainment. Results showed the majority of those who attempted to stop traditional smoking via e-cigarette, did not succeed in quitting traditional smoking.
Alsanea et al.	A cross-sectional	61.6% had never used e-	62.8% of the students perceived using e-

(2022) Prevalence, knowledge and attitudes toward electronic cigarette use among male health colleges students in Saudi Arabia	survey-based study conducted exclusively among 333 students in five health colleges over a four months period.	cigarettes. 22.8% used e-cigarettes for recreation. 15.6% used e-cigarettes for smoking cessation.	cigarettes as a fashionable, alternative, smoking method. 59.2% believed they may be rid of smoking addiction.
Alzahrani et al. (2023) The Prevalence of Electronic Cigarette Use Among College Students of Taibah University and Symptoms of Cardiovascular Disease	A cross-sectional study conducted among 519 students of Taibah University between 2021 and 2022.	The prevalence rate of e-cigarette use was 24% compared to 76% who never used e-cigarette.	51% of the students used e-cigarettes to enjoy the flavor. 49% of the students used e-cigarettes to quit tobacco smoking. 18% of the students used e-cigarettes to improve depression. Interestingly, 71.1% of e-cigarette users believed that e-cigarette is safe or less dangerous than tobacco smoking.
Alrajih et al. (2022) E-Cigarette Use among Male Smokers in Al-Ahsa, Kingdom of Saudi Arabia	A cross-sectional study on 325 adult, male, current smokers in the Al-Ahsa province of Saudi Arabia.	33.5% of the participants were e-cigarette users and 66.5% were traditional cigarette smokers. About half of the traditional smokers 49.1% attempted to quit smoking within the past 30 days, and over half of them 50.5% reported smoking for the past 6 years or more.	55.7% of the smokers reported peer effect as the reason for using e-cigarettes. 38.7% used e-cigarettes for stress-relief. 36.6% used e-cigarettes for enjoyment.
Alhuwayji et al. (2024) Prevalence of Electronic Cigarette Use Among Female Residents of Al-Ahsa, Kingdom of Saudi Arabia	A cross-sectional study conducted between October 2023 and July 2024, involving 491 adult, female participants.	17.5% of the 491 participants were e-cigarettes users. Significant factors associated with e-cigarette use included age; highest among women aged 21 to 30 years, unemployment, perceived poor health, and having friends or family members who use e-cigarettes.	70.9% used e-cigarettes due to the influence of friends. 54.7% used e-cigarettes due to the influence of family members. 33.7% used e-cigarettes for curiosity. 30.2% used e-cigarettes for appealing flavors. A considerable proportion of users reported experiencing dependence and difficulty quitting.
Karboujiet al. (2018) Awareness and Attitude toward Smoking E-Cigarettes (Vape) among Smokers in Saudi Arabia	A cross-sectional study conducted on 1404 individuals living in Saudi.	18.9% were current, traditional cigarettes smokers. 48.2% considered much satisfaction with e-cigarettes when compared with traditional cigarettes smoking.	39.3% used e-cigarettes because they think it's safe. 35.4% used e-cigarettes to quit smoking. 16.3% used e-cigarettes for curiosity or for pleasure.

DISCUSSION

This study aimed to systematically analyze the prevalence and attitudes towards e-cigarette usage among the Saudi population. This report can be helpful in identifying the main reasons why people take to the e-cigarettes, thereby helping the policymakers to take effective and appropriate steps to counter the marketing and advertising strategies with the aim to reduce the usage and sale of e-cigarettes.

This systematic review discovered that the most popular reason reported in the literature for using e-cigarettes was to quit or reduce tobacco use. Alzahrani et al., in 2021 reported that nearly one third of the sample under consideration used e-cigarettes for enjoyment. Alsanea et al. reported in 2022 that 62.8 per cent of university students perceived using e-cigarettes as a fashionable, alternative, smoking method. Alzahrani et al. (2023) found the enjoyable flavors as the main reason for using e-cigarettes among 51 per cent of 519 university students in the study.

These studies also reported that the desire to quit regular cigarettes was a reason for using e-cigarettes. Alsanea et al. (2022) reported that 59.2 per cent of the study sample believed that they may give up smoking addiction by using e-cigarettes. Alzahrani et al. (2023) reported that 49 per cent of the study sample used e-cigarettes to quit traditional smoking (49%).

Peer or family influence was found to be another major reason why people use e-cigarettes. Alhuwayji et al. (2024) reported that 70.9 per cent and 54.7 per cent of the study sample used e-cigarettes influenced by their friends and family members, respectively. Alrajih et al. (2022) reported peer and family influence as the reasons for smoking initiation among 55.7 per cent of the study sample.

These studies showed that the leading reason of e-cigarette use among university students was the enjoyable flavor rather than other reasons. The studies also showed that male smokers used e-cigarettes to quit traditional smoking, and female smokers used e-cigarette as a result of peer and family influence. These findings showed that younger people i.e., university students find e-cigarette flavor enjoyable, unlike older people who try to quit smoking tobacco by using e-cigarettes. Interestingly, some e-cigarette users believed that e-cigarette is safe or less dangerous than traditional tobacco smoking.

Studies have consistently indicated that a lack of awareness of the health risks associated with e-cigarettes is a primary factor influencing their adoption. Alzahrani et al. (2023) found that 71.1 per cent perceived e-cigarettes as a safe or less dangerous option than tobacco smoking. Karbouji et al. (2018) reported that 32.8% of their study sample considered e-cigarettes to have no effect on health and 50.3% of their study sample did not know the effects of e-cigarettes on health.

In the studies reported elsewhere, many other reasons have been cited: These include e-cigarette affordability compared to traditional cigarettes, as well as the convenience of accessibility. Additionally, some users perceive e-cigarettes as being more modern or high-tech. To avoid the unpleasant odor of cigarette smoke, many individuals have turned to e-cigarettes. Furthermore, studies have revealed that e-cigarettes are often seen as a more socially acceptable alternative to traditional cigarettes in public settings. Additionally, some e-cigarette users have reported that the discreet nature of e-cigarettes makes them easier to conceal from parents or teachers.

The Health Implications of E-Cigarettes

E-cigarettes pose significant health risks despite being marketed as safe/safer alternatives to traditional cigarettes. The delivery of nicotine, a highly addictive substance, through e-cigarettes has led to a surge in nicotine dependence, particularly among young people. Early nicotine exposure can have detrimental effects on brain development, with long-term consequences for cognitive function and behavior.

Furthermore, e-cigarette contain a complex mixture of chemicals, including nicotine, volatile organic compounds, and harmful ultrafine particles. Exposure to these substances can lead to respiratory, cardiovascular, and other health problems. The potential for secondhand exposure to e-cigarette aerosol is also a concern, as it can adversely affect the health of non-smokers.

Public health significance and Policy Recommendations

The increasing prevalence of e-cigarettes has emerged as a significant public health challenge. Aggressive marketing strategies and the perception of e-cigarettes as a safe/safer alternative to traditional cigarettes have contributed to their widespread adoption, particularly among the young people. However, mounting evidence suggests that e-cigarettes pose substantial health risks.

The rising popularity of e-cigarettes necessitates a comprehensive understanding of their health risks. The addictive nature of nicotine, the potential for long-term health consequences, and the risks associated with secondhand exposure highlight the urgent need for public health interventions to address this issue.

To address the growing e-cigarette epidemic, comprehensive public health interventions are essential. Key strategies and policies include:

- **Stricter Regulations:** Implementing robust regulations to control the marketing, sale, and use of e-cigarettes, particularly among the youth.
- **Public Awareness Campaigns:** Educating the public about the health risks associated with e-cigarette use, including the addictive nature of nicotine and the potential for long-term harm.
- **Smoking Cessation Programs:** Expanding access to effective smoking cessation programs that address both traditional and e-cigarette use and addiction.
- **Research and Monitoring:** Continued research to better understand the long-term health consequences of e-cigarette use and to develop effective prevention and treatment strategies.

By adopting a multifaceted approach, policymakers and public health officials can eliminate e-cigarettes usage and protect public health.

Limitations

It is important to acknowledge that the available research on e-cigarettes is still evolving. While this review provides valuable insights, further studies are needed to fully understand the long-term health consequences of e-cigarette use. Additionally, the focus on the Saudi population limits the generalizability of these findings to other populations.

CONCLUSION

This comprehensive review of existing literature suggests that e-cigarettes may not be as innocuous as perceived by many users. Despite their promotion as a safe/safer alternative to traditional cigarettes, evidence indicates that e-cigarettes pose significant health risks comparable to those associated with other tobacco products. This alarming trend necessitates urgent attention and further investigation. Well-designed clinical trials are imperative to thoroughly assess the safety and efficacy of e-cigarettes. Such studies will provide crucial insights into, amongst others, their potential to reduce traditional cigarette usage. The global adoption of e-cigarette, particularly among young people, underscores the urgent need to prevent any setbacks in the progress made to curb traditional cigarette smoking. Implementing robust policies at all levels is essential to address the growing prevalence of e-cigarettes. Strict measures should be enacted to tackle this: restricting youth's access to them, imposition of heavy taxes on e-cigarette products, regulating retail licensing, and curbing marketing practices that appeal to young people. Educational initiatives targeting youth and young adults are also crucial in this campaign. Health professionals play a significant role in educating the public, particularly the young people, about the risks associated with e-cigarettes. By raising awareness, health professionals can contribute significantly to tackling the e-cigarette epidemic in Saudi Arabia.

REFERENCES

1. Grana R, Benowitz N, Glantz SA. E-cigarettes: a scientific review. *Circulation* 2014;129:1972e86. <https://doi.org/10.1161/CIRCULATIONAHA.114.007667>.
2. Bhatnagar A. Cardiovascular perspective of the promises and perils of E-cigarettes. *Circ Res* 2016;118:1872e5. <https://doi.org/10.1161/CIRCRESAHA.116.308723>.
3. Zhang G, Wang Z, Zhang K, Hou R, Xing C, Yu Q, et al. Safety assessment of electronic cigarettes and their relationship with cardiovascular disease. *Int J Environ Res Publ Health* 2018;15. <https://doi.org/10.3390/ijerph15010075>.
4. Bener A, Erdogan A, Griffiths MD: The impact of cigarette smoking, water-pipe use on hearing loss/hearing impairment: a cross-sectional study. *Asian Pac J Cancer Prev.* 2024, 25:109-14. [10.31557/APJCP.2024.25.1.109](https://doi.org/10.31557/APJCP.2024.25.1.109)
5. Alasqah I, Mahmud I, East L, Usher K: A systematic review of the prevalence and risk factors of smoking among Saudi adolescents. *Saudi Med J.* 2019, 40:867-78. [10.15537/smj.2019.9.24477](https://doi.org/10.15537/smj.2019.9.24477)
6. West R: Tobacco smoking: Health impact, prevalence, correlates and interventions. *Psychol Health.* 2017, 32:1018-36. [10.1080/08870446.2017.1325890](https://doi.org/10.1080/08870446.2017.1325890)
7. Hartmann-Boyce J, Lindson N, Butler AR, et al.: Electronic cigarettes for smoking cessation. *Cochrane Database Syst Rev.* 2022, 11:CD010216. [10.1002/14651858.CD010216.pub7](https://doi.org/10.1002/14651858.CD010216.pub7)
8. Lindson N, Butler AR, McRobbie H, et al.: Electronic cigarettes for smoking cessation. *Cochrane Database Syst Rev.* 2024, 1:CD010216. [10.1002/14651858.CD010216.pub8](https://doi.org/10.1002/14651858.CD010216.pub8)
9. Kapiamba KF, Owusu SY, Wu Y, Huang YW, Jiang Y, Wang Y: Examining the oxidation states of metals in aerosols emitted by electronic cigarettes. *Chem Res Toxicol.* 2024, 37:1113-20. [10.1021/acs.chemrestox.4c00033](https://doi.org/10.1021/acs.chemrestox.4c00033)
10. Muthumalage T, Noel A, Thanavala Y, Alcheva A, Rahman I: Challenges in current inhalable tobacco toxicity assessment models: a narrative review. *TobInduc Dis.* 2024, 22: [10.18332/tid/188197](https://doi.org/10.18332/tid/188197)
11. Hamberger ES, Halpern-Felsher B: Vaping in adolescents: epidemiology and respiratory harm. *Curr Opin Pediatr.* 2020, 32:378-83. [10.1097/MOP.0000000000000896](https://doi.org/10.1097/MOP.0000000000000896)
12. Al Rajeh AM, Mahmud I, Al Imam MH, et al.: E-cigarette use among male smokers in Al-Ahsa, Kingdom of Saudi Arabia: a cross-sectional study. *Int J Environ Res Public Health.* 2022, 20:143. [10.3390/ijerph20010143](https://doi.org/10.3390/ijerph20010143)
13. 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.* 2023, 31:102089. [10.1016/j.pmedr.2022.102089](https://doi.org/10.1016/j.pmedr.2022.102089)
14. O'Connor R, Schneller LM, Felicione NJ, Talhout R, Goniewicz ML, Ashley DL: Evolution of tobacco products: recent history and future directions. *Tob Control.* 2022, 31:175-82. [10.1136/tobaccocontrol-2021-056544](https://doi.org/10.1136/tobaccocontrol-2021-056544)
15. Khanagar, Sanjeev Balappa¹; Siddeeqh, Salman²; Khinda, Vineet¹; Khinda, Paramjit¹; Divakar, Darshan Devang³; Jhugroo, Chitra⁴. Impact of electronic cigarette smoking on the Saudi population through the analysis of literature: A systematic review. *Journal of Oral and Maxillofacial Pathology* 23(3):p 473, Sep-Dec 2019. | DOI: [10.4103/jomfp.JOMFP_141_19](https://doi.org/10.4103/jomfp.JOMFP_141_19)

16. Etim N, Pike J, Xie B: Age-varying associations between e-cigarette use and peer use, household use, and exposure to e-cigarette commercials among alternative high school students in Southern California. *TobInduc Dis.* 2020, 18:7. 10.18332/tid/116412
17. Alzahrani, Z., Zaidi, S. F., Alsolami, H., Bashrahil, B., Alghamdi, N., Nooh, M., Khan, M. A., Alshanberi, A. M., & Qanash, S. (2021). Electronic cigarettes consumption and associated factors among general population in Western Saudi Arabia. *Journal of public health research*, 11(1), 2346. <https://doi.org/10.4081/jphr.2021.2346>
18. Alsanea, S., Arabiah, Z., Samreen, S., Syed, W., Bin Khunayn, R. M., Al-Arifi, N. M., Alenazi, M., Alghadeer, S., Alhossan, A., Alwhaibi, A., & Al-Arifi, M. N. (2022). Prevalence, knowledge and attitude toward electronic cigarette use among male health colleges students in Saudi Arabia-A cross-sectional study. *Frontiers in public health*, 10, 827089. <https://doi.org/10.3389/fpubh.2022.827089>
19. Alzahrani, T., Alhazmi, M. F., Alharbi, A. N., AlAhmadi, F. T., Alhubayshi, A. N., & Alzahrani, B. A. (2023). The Prevalence of Electronic Cigarette Use Among College Students of Taibah University and Symptoms of Cardiovascular Disease. *Journal of the Saudi Heart Association*, 35(2), 163–168. <https://doi.org/10.37616/2212-5043.1338>
20. Al Rajeh, A. M., Mahmud, I., Al Imam, M. H., Rahman, M. A., Al Shehri, F., Alomayrin, S., Alfazae, N., Elmosaad, Y. M., & Alasqah, I. (2022). E-Cigarette Use among Male Smokers in Al-Ahsa, Kingdom of Saudi Arabia: A Cross-Sectional Study. *International journal of environmental research and public health*, 20(1), 143. <https://doi.org/10.3390/ijerph20010143>
21. Alhuwayji A A, Alhamam A M, Alramdan M, et al. (August 09, 2024) Prevalence of Electronic Cigarette Use Among Female Residents of Al-Ahsa, Kingdom of Saudi Arabia: A Cross-Sectional Study. *Cureus* 16(8): e66533. doi:10.7759/cureus.66533
22. Karbouji, M., Abduldaem, A., Allogmani, A., Alnozha, O., Al-Zalabani, A. (2018). Awareness and Attitude toward Smoking E-Cigarettes (Vape) among Smokers in Saudi Arabia 2017. *The Egyptian Journal of Hospital Medicine*, 20 (8), 1364-1351. Doi: 10.12816/0044646