Non communicable disease

Assessing the Association Between Head and Neck Cancers and Electronic Cigarette Use as Compared to Conventional Cigarette Use: Analysis of Results from National Health Interview Survey 2020-2022

AMAL MOHAMMED SUNYUR[1], DUAA SALEM ALKHAYAT[1], MOHAMMED ABDULLAH ALAHMADI[1], HEBA ADNAN MOHAMMAD[1], SULAIMAN ABDULLAH[1], ZAKARIA YAHYA KHAWAJI[1], AHMAD SALIM BADAWI[1]
[1] College of Medicine, Taibah University, Madina, Saudi Arabia

Keywords

Tobacco Smoking • Electronic Cigarette • Squamous Cell Carcinoma of Head and Neck • Laryngeal cancer • Oral Cavity Squamous Cell Carcinoma

Summary

Objectives. *Head and neck cancers (HNC) are major global issues that are associated with tobacco use. The increasing prevalence of electronic cigarettes (e-cigarettes) necessitates exploring their health risks. The aim of the study is to identify the HNC risk associated of e-cigarettes compared to conventional cigarettes.*
Methods. *Data from the National Interview Health Survey (NHIS) from 2020-2022 was analyzed. The diagnosis of HNC was the primary outcome. Exposure included electronic and conventional cigarette use. Regression analysis was used to establish the relationship between both variables.*
Results. *The study included 77,419 individuals, with 409 of whom were diagnosed with HNC. Conventional cigarette use was higher in the HNC group compared to the non-HNC group (46.6% vs. 32.3%, p<0.001) with a higher risk of HNC (OR: 1.583, p<0.001). Subgroup analysis showed elevated risk of developing laryngeal cancer (OR: 11.774), pharyngeal cancer (OR: 2.329), and mouth and tongue cancer (OR: 1.08, p<0.001 for all) with conventional cigarettes. E-cigarette use had a lower prevalence in the HNC group (15%) compared to the non-HNC group (18.4%, p<0.001), but higher odds of having HNC (OR: 1.619, p<0.001), particularly for mouth and tongue cancer (OR: 5.18) and pharyngeal cancer (OR: 1.19, p<0.001 for both).*
Conclusion. *Electronic cigarette use is associated with an increased risk of head and neck cancers, comparable to that of conventional cigarette use. This highlights the need for further research on the long-term effects of e-cigarette use.*

Introduction

Electronic cigarettes (E-cigarettes) are handheld vaping devices that use electricity to aerosolize a nicotine-containing liquid. The use of e-cigarettes among individuals of various age groups is growing rapidly, especially since it is sometimes used to help conventional cigarette smokers stop smoking. This necessitates the investigation of their health-related consequences to regulate their use and limit the increase of health issues, given that the health effects of electronic cigarette use are sparse [1].

Head and neck cancer (HNC) is a broad range of cancers that originate in the head and neck regions, including malignancies of the oral cavity, nasopharynx, oropharynx, larynx, and hypopharynx [2, 3]. More than 90% of head and neck cancers are head and neck squamous cell carcinoma (HNSCC), which develops from the epithelial linings of the oral cavity, hypopharynx, oropharynx, and larynx [4]. HNC accounts for approximately 660,000 new cases and 325,000 deaths yearly, making HNC the seventh most common cancer worldwide [2]. Regarding the epidemiology of HNC in the United States in 2019, there were 10,860 HNC-related deaths and 53,000 new cases. It is anticipated that by 2030, there will be a 30% yearly increase in the overall incidence of HNC [5, 6].

The risk factors for HNC include smoking, alcohol consumption, Epstein-Barr virus (EBV), and human papillomavirus (HPV) infection. Tobacco and alcohol remain the main risk factors, while HPV infection has increasingly contributed to HNC incidence [3,7]. Also, smoking is proposed to be related to increasing mortality rates in a dose-dependent manner, especially when exposure occurs before diagnosis [8].

Cigarette smoking is a known risk factor for the development of laryngeal cancer [9] and oropharyngeal cancer [10]. However, it has been shown in multiple studies that smoking decreases the risk of developing thyroid cancer [11-13]. Data concerning the effect of e-cigarette use on the development of head and neck cancer are still inconclusive, with a notable lack of longitudinal and controlled studies to establish a clear association [14].

https://doi.org/10.82082/2421-4248/jpmh2026.67.2.3424

Methods

Study design and population

In this study, we retrospectively analyze data from the National Health Interview Survey (NHIS). NHIS is a wide-scale interview-based survey that aims to collect information related to health and disease from adults residing in the United States [15]. Data from the years 2020, 2021, and 2022 were used in this study to assess the relationship between the occurrence of head and neck cancers and electronic cigarette use and compare them to conventional cigarette use. Subjects who have had any other type of cancer were excluded from this study. Therefore, those who mentioned any type of the following cancers, did not know if they had them, or refused to answer were excluded from the study: colorectal cancer, uterine cancer for females, stomach cancer, skin cancer (melanoma, non-melanoma, or unidentified types), rectal cancer, prostate cancer for males, pancreatic cancer, ovarian cancer for females, melanoma, lymphoma, lung cancer, liver cancer, leukemia, gall bladder cancer, esophageal cancer, colon cancer, cervical cancer for female subjects, breast cancer, brain cancer, bone cancer, blood cancer, bladder cancer, or other cancers (n=77419).

Variables of the study

Dependent variable (outcome)

The occurrence of head and neck cancers (namely thyroid cancer, laryngeal cancer, throat/pharyngeal cancer, mouth, tongue, and lip cancer) is the dependent variable in this study. It was assessed by asking the participants directly if any of the previously named cancers were mentioned to them by a doctor or other healthcare professional. Those who answered "yes" when asked if thyroid, laryngeal, throat/pharyngeal, mouth, tongue, or lip cancers were mentioned were considered to have the respective type of cancer. Only those who answered "yes" to the question "Have you ever been told by a doctor or other health professional that you had... cancer or a malignancy of any kind?" were asked about specific cancer types afterwards. Those who answered with "I don't know", "not ascertained", or refused to answer were excluded from the study population.

Independent variable (exposure of interest)

In this study, electronic cigarette use and conventional cigarette use are considered to be independent variables. These variables were assessed by asking subjects, "Do you now use e-cigarettes or other electronic vaping products every day, some days, or not at all?" and "Do you now smoke cigarettes every day, some days, or not at all?" Anyone who answered with "some days" or "every day" was considered to be a current electronic cigarette and conventional cigarette user.

Demographic and clinical covariates

In this study, we considered demographic covariates like age (collected as a continuous variable), gender, marital status, race, and educational level. Direct questions were used to assess each of the previously mentioned factors. As for clinical factors, we considered the presence of comorbid conditions including hypertension, prediabetes, and diabetes, using the following questions: "Have you ever been told by a doctor or other health professional that you had... hypertension, also called high blood pressure?"; "Has a doctor or other health professional ever told you that you had prediabetes or borderline diabetes?"; and "Has a doctor or other health professional ever told you that you had diabetes?". BMI was calculated and was gathered categorically as either "underweight", "healthy weight", "overweight", "obese", or "unknown". Furthermore, we considered possible confounders that may interfere with the results of the study, like cigar smoking, pipe smoking, and smokeless tobacco. These factors were gathered by asking the participants about the frequency of cigar or pipe smoking and the use of smokeless tobacco. Every day and some day users were considered to be current users.

Statistical analysis

In this paper, the categorical data of the subjects in this study were reported as percentages, and continuous data were reported as medians. The occurrence of any of the previously mentioned head and neck cancers was evaluated among users of electronic cigarettes and conventional cigarettes. Regression analysis was used to control for confounding factors. We used a chi-square test to compare the occurrence of head and neck cancers among users and non-users of both electronic cigarettes and conventional cigarettes.

Results

This study included a total of 77,419 individuals, 409 of whom were diagnosed with head and neck cancers; the other 77,010 were categorized as non-H&N cancer subjects. Table I shows the baseline characteristics of the population in the study. In terms of gender distribution, males constituted 48.8% of the total population, with 39.1% of the head and neck cancer group and 48.9% of the non-head and neck cancer group, having a statistically significant difference between both groups ($p<0.001$). As for the race, the population of our study shows notable diversity. Hispanic racial origins constituted 18.1% of the total population, with a lower percentage among the head and neck cancer group (13.4%, $p<0.001$). Asians and African Americans had a total percentage of 6.4% and 12.3%, with higher rates among the non-head and neck cancer group (6.4% and 12.3%, $p<0.001$). White origins constituted 60.4% of the entire population, with a higher percentage in the head and neck cancer group (73.2%) compared to the non-head and neck cancer group (60.3%, $p<0.001$).

Regarding BMI, 1.6% were classified as underweight, 31.5% were classified as healthy weight, 33.1% were classified as overweight, and 33.8% were classified as

Tab. I. Baseline characteristics of H&N cancer and non-H&N cancer patients.

	Total	H&N cancer	Non-H&N cancer	*p-value*
Number	77419	409	77010	
Gender: male (%)	48.8	39.1	48.9	<0.001
Race				
Hispanic (%)	18.1	13.4	18.1	<0.001
American Indians (%)	1.5	2.6	1.5	
Asian (%)	6.4	4.5	6.4	
African American (%)	12.3	6	12.3	
White (%)	60.4	73.2	60.3	
Other races (%)	1.4	0.4	1.4	
BMI				
Underweight (%)	1.6	1.9	1.6	<0.001
Healthy weight (%)	31.5	26.3	31.5	
Overweight (%)	33.1	31.6	33.8	
Obese (%)	33.8	40.2	33	
History of chronic diseases				
History of HTN (Y, (%))	29.2	49.1	29.1	<0.001
Borderline diabetes (Y, (%))	13.4	20.9	13.4	<0.001
History of DM (Y, (%))	8.7	13.3	8.7	<0.001
History of Smoking				
Conventional cigarettes smoking (%)	32.4	46.6	32.3	<0.001
e-Cigarettes smoking (%)	18.4	15	18.4	<0.001
Smoking cigars (Y, (%))	3.6	3.6	0.8	<0.001
Smoking pipe (Y, (%))	1	0.3	1	<0.001
Receiving smokeless tobacco (Y, (%))	2.2	0.9	2.2	<0.001

obese. Notably, obesity was significantly more prevalent among the head and neck cancer group than the non-head and neck cancer group (40.2% *vs*. 33%, $p<0.001$), and healthy weight was more common in the non-head and neck cancer group (31.5%) compared to the head and neck cancer group (26.3%, $p<0.001$).

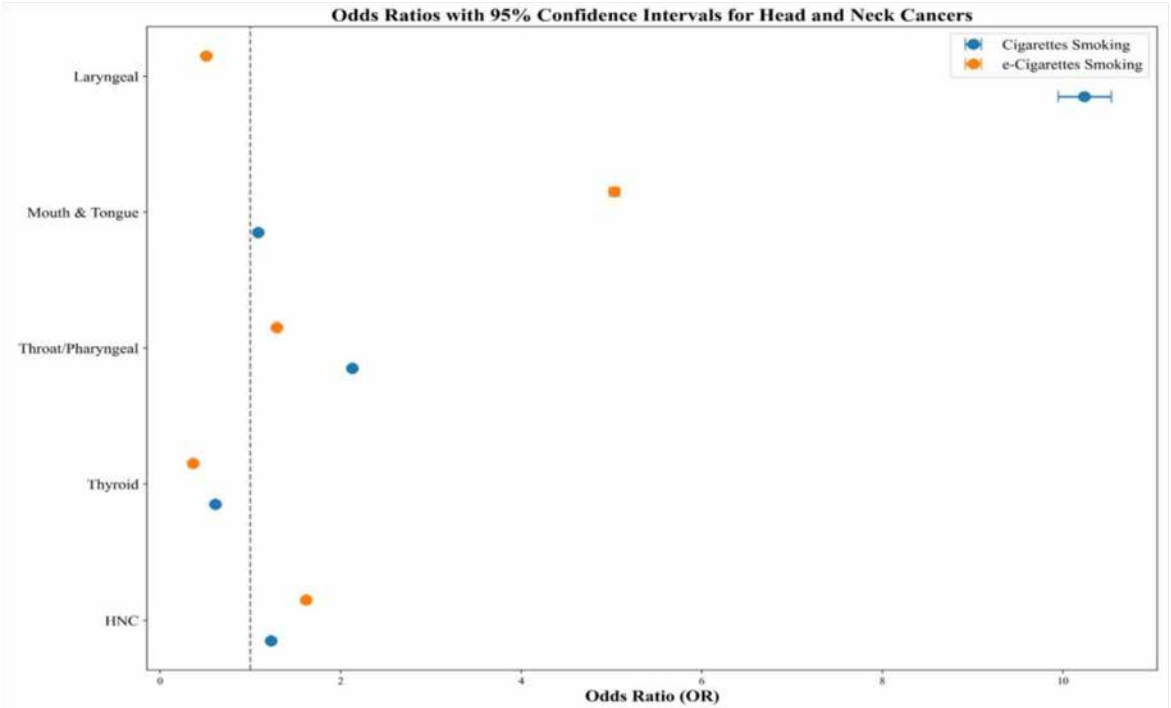
For history of chronic diseases, comorbid conditions were observed to have a higher prevalence among those with head and neck cancers compared to the non-head and neck cancer subjects; these comorbidities include hypertension (49.1% *vs*. 29.1%, $p<0.001$), borderline diabetes (20.9% *vs*. 13.4%, $p<0.001$), and diabetes mellitus (13.3% *vs*. 8.7%, $p<0.001$).

The smoking history of the subjects involved in this study showed that 32.4% of the total population smoked conventional cigarettes, with the percentage being higher among the head and neck cancer patients (46.6%) compared to the non-head and neck cancer subjects (32.2%, $p<0.001$). For e-cigarette use, 18.4% of the entire population reported electronic cigarette use, with a lower percentage of e-cigarette users among the cancer patients compared to the non-cancer subjects (15% *vs*. 18.4%, $p<0.001$).

Figure 1 shows the multivariate analysis after adjustment for age and gender. Conventional cigarette use showed increased risk of overall head and neck cancers, as shown by its odds ratio (OR: 1.23, 95% CI: 1.226-1.23, $p<0.001$). This was similarly evident in e-cigarette use, which also showed increased odds of developing head and neck cancers (OR: 1.619, 95% CI: 1.615-1.622, $p<0.001$). As for thyroid cancer, a decreased risk was shown in both conventional cigarette use (OR: 0.614, 95% CI: 0.611-0.618, $p<0.001$) and electronic cigarette use (OR: 0.367, 95% CI: 0.364-0.37, $p<0.001$). Throat/pharyngeal cancer were associated with an increased risk in both types of smoking, with the odds for conventional cigarette use (OR: 2.13, 95% CI: 2.114-2.145, $p<0.001$) higher than the odds for e-cigarette use (OR: 1.295, 95% CI: 1.283-1.307, $p<0.001$). Regarding oral and tongue cancers, a significant increase in odds of developing the cancer was noted with electronic cigarette use (OR: 5.032, 95% CI: 4.976-5.088, $p<0.001$) compared to conventional cigarette use, which showed a minor increase in odds (OR: 1.087, 95% CI: 1.077-1.098, $p<0.001$). Conversely, the risk of developing laryngeal cancer was largely higher with conventional cigarette use than with e-cigarette use, which showed a lower risk of developing the cancer (OR: 10.239, 95% CI: 9.949-10.537, $p<0.001$) versus (OR: 0.512, 95% CI: 0.496-0.528, $p<0.001$).

Similar trends were observed after adjusting for age, gender, hypertension, and diabetes mellitus (Fig. 2). Overall, head and neck cancer risk was increased in both conventional cigarette use (OR: 1.583, 95% CI: 1.580-1.587, $p<0.001$) and electronic cigarette use (OR: 1.619, 95% CI: 1.615-1.622, $p<0.001$). Thyroid cancer risk was also lower with electronic cigarette use (OR: 0.347, 95% CI: 0.344-0.349, $p<0.001$) and conventional cigarette use (OR: 0.585, 95% CI: 0.582-0.589, $p<0.001$) after adjusting for hypertension and diabetes.

Fig. 1. The likelihood of developing head and neck cancers among conventional cigarette and electronic cigarette use groups after adjusting for age and gender.



Multivariate Analysis

	HNC		Thyroid cancer		Throat/Pharyngeal		Mouth & Tongue		Laryngeal	
	OR	CI	OR	CI	OR	CI	OR	CI	OR	CI
Cigarettes smoking										
Non-smoker	Reference									
Smoker	1.23	1.226-1.23	0.614	0.611-0.618	2.13	2.114-2.145	1.087	1.077-1,098	10.239	9.949-10.537
e-Cigarettes smoking										
Non-smoker	Reference									
Smoker	1.619	1.615-1.622	0.367	0.364-0.37	1.295	1.283-1.307	5.032	4.976-5.088	0.512	0.496-0.528

- Adjusted for age and gender

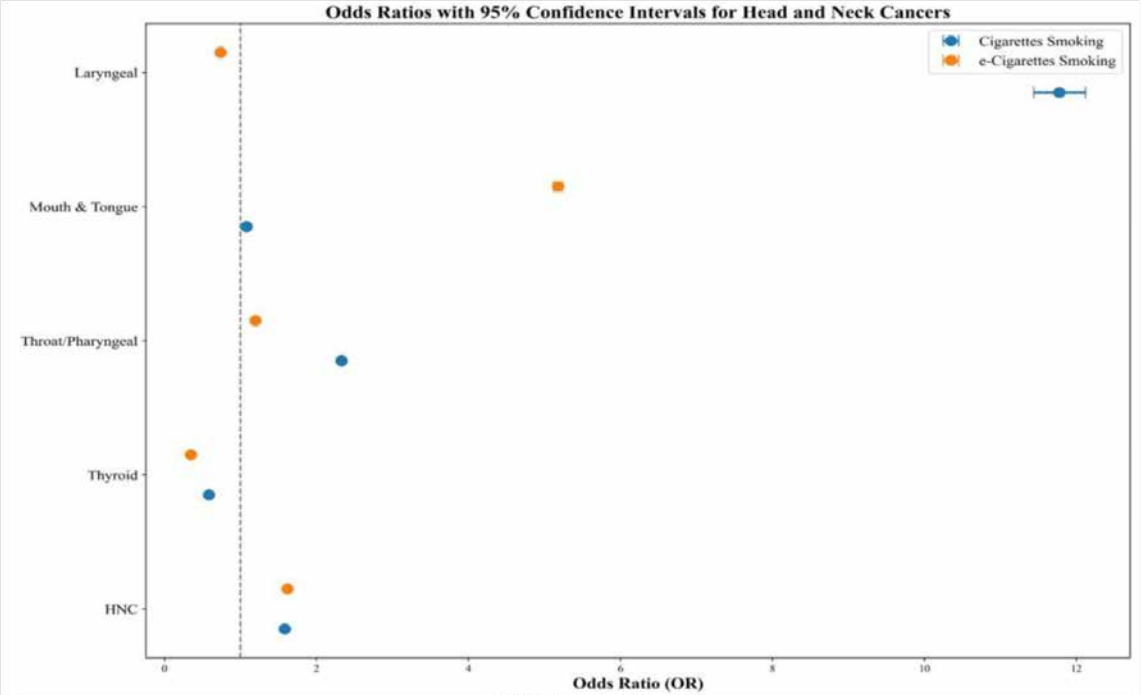
Furthermore, conventional cigarettes exhibited a higher risk for developing throat/pharyngeal cancer (OR: 2.329, 95% CI: 2.312-2.346, $p<0.001$) and laryngeal cancer (OR: 11.774, 95% CI: 11.44-12.118, $p<0.001$) compared to electronic cigarette use (OR: 1.197, 95% CI: 1.185-1.208, $p<0.001$) and (OR: 0.738, 95% CI: 0.715-0.762, $p<0.001$). Mouth and tongue cancer had more odds with electronic cigarette use (OR: 5.18, 95% CI: 5.122-5.239, $p<0.001$) compared to conventional cigarette use (OR: 1.08, 95% CI: 1.07-1.09, $p<0.001$).

Discussion

This study represents a pioneering effort to investigate the risk of head and neck carcinomas (HNCs) among e-cigarettes users versus traditional smokers. Our study utilized the NHIS database and analyzed a cohort of 409 patients diagnosed with HNC. The demographic characteristics of our sample were predominantly female (60.9%), with a high prevalence of obesity (40.2%), hypertension (49.1%), and to a lesser extent DM (13.3%), which may serve as potential confounding factors. These findings resonate with existing literature that indicates DM and HTN have been linked to an increased risk of oral, laryngeal, and esophageal cancers. Also, DM may contribute to more aggressive head and neck tumors due to factors like high blood sugar, insulin resistance, inflammation, and weakened immunity [16, 17]. Furthermore, studies have shown that the combination of hypertension and diabetes significantly increases the risk of these cancers, even in non-smokers [17].

Our study agreed with the current data regarding the correlation between smoking and HN carcinogenesis [18, 19], as the cumulative risk of head and neck carcinoma among cigarette smokers and e-cigarette smokers was shown to be comparable (adjusted odd ratio [aOR]: 1.583, CI 95%: 1.580-1.587 *vs*. aOR: 1.619, CI 95%: 11.615-1.622, respectively). Supporting the positive correlation, the Carolina Head and Neck Cancer

Fig. 2. The likelihood of developing head and neck cancers among conventional cigarette and electronic cigarette use groups after adjusting for age, gender, diabetes mellitus and hypertension.



Multivariate Analysis

	HNC		Thyroid cancer		Throat/Pharyngeal		Mouth & Tongue		Laryngeal	
	OR	CI	OR	CI	OR	CI	OR	CI	OR	CI
Cigarettes smoking										
Non-smoker	Reference									
Smoker	1.583	1.580-1.587	0.585	0.582-0.589	2.329	2.312-2.346	1.08	1.07-1.09	11.774	11.44-12.118
e-Cigarettes smoking										
Non-smoker	Reference									
Smoker	1.619	1.615-1.622	0.347	0.344-0.349	1.197	1.185-1.208	5.18	5.122-5.239	0.738	0.715-0.762

- Adjusted for age, gender, DM and HTN

Study, which includes 1,153 cases, demonstrated that the adjusted OR of current smoking status is 4.16. . The OR was adjusted for sex, race, age, pack-year smoking history, total lifetime alcohol consumption, smokeless tobacco use, family history of cancer, and oral health parameters [20]. The findings of this large-scale study are consistent with those from the International Head and Neck Cancer Epidemiology (INHNCE) consortium, which encompasses 32 control-case studies with over 19,000 HNC cases. The results of the pooled analysis indicated a direct correlation between the frequency of cigarette smoking and HNC risk, with even minimally daily smoking (>0-3 cigarettes per day) being associated with a 50% increase in risk (OR: 1.52, 95% CI: 1.21-1.90). This trend was more evident in laryngeal cancer, where the highest probability was observed among those who smoked >5-10 cigarettes per day [21]. However, these studies do not specifically examine the effect of electronic cigarettes as a potential risk factor for HNC. Our results indicate conventional smoking and e-cigarette smoking have similar odds of increasing the risk of the prevalence of HNC cases, possibly due to various probable carcinogens in e-liquids, including aromatic amino acids, N-nitrosamines, or volatile hydrocarbons. Although these substances are found in lower quantities in e-cigarettes compared to traditional non-filtered cigarettes, their presence could contribute to the increasing likelihood of developing HNCs [22].

Laryngeal cancer is the second most tobacco-related cancer in Europe, following lung cancer, according to GLOBOCAN 2018 data [23]. Cigarette smoking was significantly associated with laryngeal cancer (aOR: 11.77, 95% CI: 11.44-12.11) in our study. This finding came consistent with the Korean National Health Insurance Service database study published in 2022, which confirmed the positive relationship between smoking and laryngeal cancer with an increasing incidence rate among smokers (OR: 3.256, 95% CI: 2.945-3.599, $p<0.0001$) after adjustment of potential confounders [24]. In contrast, our study showed that

e-cigarettes were not associated with a significant risk of laryngeal cancer (aOR: 0.738, 95% CI: 0.71-0.76). In spite of these findings, two systematic reviews of experimental studies have suggested that e-cigarettes may pose a carcinogenic risk for head and neck carcinoma. They concluded that multiple chemical components found in e-cigarettes can cause DNA damage, increase oxidative stress, and induce metaplasia [14, 25]. However, no clinical longitudinal studies have yet examined this association. Surprisingly, our results were not consistent with the current understanding of the association between e-cigarettes and laryngeal cancer.

A population-based cohort study conducted in Japan in 2018 showed a hazard ratio of 2.37 (95% CI 1.51-3.70) among smokers in the risk of increasing incidence of oral cavity and pharyngeal cancer [26]. Our study showed that e-cigarette smoking was associated with increasing odds of oral cavity cancers (aOR: 5.18, 95% CI: 5.12-5.23), with a lesser association observed for conventional cigarette smoking (aOR: 1.08, 95% CI: 1.07-1.09). Our data differ from the findings of the ICARE study based in France, which highlighted that not only smoking status but also the duration contributes to the rising trend of oral cavity cancers [<30 years of smoking; (OR: 3.9, 95% CI: 2.7-5.8), >30 years of smoking; (OR 9.4, 95% CI: 6.3-13.9)] [27]. There is a positive correlation between e-cigarettes and tongue and lip cancers demonstrated in three case reports where e-cigarettes were the exceptional possible incriminating factor for the development of basaloid and invasive squamous cell carcinoma [28, 29].

Regarding pharyngeal and throat cancers, our study showed that both cigarette smoking (aOR: 2.32, 95% CI: 2.312-2.346) and e-cigarette smoking (aOR: 1.19, 95% CI: 1.185-1.208) were associated with the development of the cancer. In a systematic review published in 2015, cigarette smoking was found to be a significant risk factor for different types of head and neck carcinoma, including pharyngeal cancer. This review demonstrated a dose-response relationship, with the risk intensifying with the duration of smoking [1-19 years of smoking (OR: 2.09, 95% CI: 1.08-4.05) *vs*. 20-39 years of smoking (OR: 3.29, 95% CI: 1.18-9.13) *vs*. >40 years of smoking (OR: 6.03, 95% CI: 2.34-15.54)] [30].

Unlike other head and neck carcinomas, thyroid cancer was revealed to be negatively associated with smoking, as demonstrated by a recent meta-analysis done in 2021 by Joon-Hyop Lee et al. (OR: 0.798, 95% CI: 0.681–0.935), corroborating earlier findings from a meta-analysis by Young Ae Cho et al. (2014) [12, 13]. A 2022 cohort study in Korea, included 89,527 patients diagnosed with thyroid cancer. The study illustrated that those who smoke are at a lower risk of developing thyroid cancer compared to those who are nonsmokers (aHR: 0.74, 95% CI: 0.72-0.76) [11]. Our study findings align with the literature, and it showed that both cigarette use (aOR: 0.585, 95% CI: 0.582-0.589) and e-cigarette use (aOR: 0.347, 95% CI: 0.344-0.349) were inversely associated with the odds of thyroid cancer. Although this inverse association may appear counterintuitive, it has been hypothesized that the suppressive effect of smoking on TSH levels thereby reducing the risk of thyroid cancer [31].

Limitations

The potential limitations of this study should be considered when interpreting the results. First, this study is based on a retrospective analysis of cross-sectionally collected information, which, despite being a good method for wide-scale epidemiological studies, cannot establish causality or temporality but rather identify possible association. Furthermore, we relied heavily on self-reported diagnoses of head and neck cancer, which can depend on the level of understanding of the patient himself and the possibility of recall bias. Also, this study analyzes head and neck cancers in general without including the histological subtypes of each cancer in the analysis. Moreover, some possible confounders were not collected by the original questionnaire and therefore were not included in the analysis, which may be related to the development of head and neck cancers.

Conclusion

In conclusion, our analysis has shown a significant association between both electronic cigarette and conventional cigarette use and head and neck cancers, with electronic cigarette use risk being higher than that of the conventional cigarettes. Furthermore, both of them have distinct patterns of cancer risk, with e-cigarettes linked to a higher risk of certain types of cancer, like mouth and tongue cancer, and conventional cigarettes having a broader risk profile, especially for pharyngeal and laryngeal cancer. These findings highlight the necessity for comprehensive preventive and smoking cessation programs. More research is needed to further elucidate the long-term effects of e-cigarette use.

Acknowledgment

Not applicable.

Funding

No funding was received to assist with the preparation of this manuscript.

Ethics approval and consent to participate

This article does not contain studies performed by the authors with human participants or animals. Ethical approval was waived for this study because secondary

data was used from the National Health Interview Survey.

Informed Consent

Informed consent was not required to conduct secondary data analysis of NHIS survey data.

Disclaimer

The content of this research is solely the responsibility of the authors and does not necessarily represent or imply any endorsement, or recommendation by the Centers for Disease Control and Prevention (CDC), the Agency for Toxic Substances and Disease Registry (ATSDR), the Department of Health and Human Services (HHS) or the Unites States Government.

Data Availability

NHIS data are publicly available on the agency website for no charge.

Conflict of interest statement

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Authors' contributions

AMS, ASB, DSA: Conceptualization. AMS: Data curation and Visualization. SA: Formal Analysis. AMS, ABA, SA: Methodology. DSA: Supervision. ZYK, DSA: Writing-Review and Editing. All authors: Writing-Original draft.

References

[1] Breland A, Soule E, Lopez A, Ramôa C, El-Hellani A, Eissenberg T. Electronic cigarettes: what are they and what do they do? Ann N Y Acad Sci 2016;1394:5-30. https://doi.org/10.1111/nyas.12977.

[2] Gormley M, Creaney G, Schache A, Ingarfield K, Conway DI. Reviewing the epidemiology of head and neck cancer: definitions, trends and risk factors. BDJ 2022;233:780-6. https://doi.org/10.1038/s41415-022-5166-x.

[3] Sun Z, Sun X, Chen Z, Du J, Wu Y. Head and neck squamous cell carcinoma: risk factors, molecular alterations, immunology and peptide vaccines. Int J Pept Res Ther 2021;28. https://doi.org/10.1007/s10989-021-10334-5.

[4] Aupérin A. Epidemiology of head and neck cancers: an update. Curr Opin Oncol 2020;32:178-86. https://doi.org/10.1097/cco.0000000000000629.

[5] Thompson-Harvey A, Yetukuri M, Hansen AR, Simpson MC, Adjei Boakye E, Varvares MA, Osazuwa-Peters N. Rising incidence of late-stage head and neck cancer in the United States. Cancer 2020;126:1090-101. https://doi.org/.1002/cncr.32583.

[6] Guo K, Xiao W, Chen X, Zhao Z, Lin Y, Chen G. Epidemiological Trends of Head and Neck Cancer: A Population-Based Study. Biomed Res Int 2021;2021:1-14. https://doi.org/10.1155/2021/1738932.

[7] Rahman QB, Iocca O, Kufta K, Shanti RM. Global burden of head and neck cancer. Oral Maxillofac Surg Clin N Am 2020;32:367-75. https://doi.org/10.1016/j.coms.2020.04.002.

[8] Beynon RA, Lang S, Schimansky S, Penfold CM, Waylen A, Thomas SJ, Pawlita M, Waterboer T, Martin RM, May M, Ness AR. Tobacco smoking and alcohol drinking at diagnosis of head and neck cancer and all-cause mortality: Results from head and neck 5000, a prospective observational cohort of people with head and neck cancer. Int J Cancer 2018;143:1114-27. https://doi.org/10.1002/ijc.31416.

[9] Zuo JingJing ZJ, Tao ZeZhang TZ, Chen Chen CC, Hu Zhang-Wei HZ, Xu YeXing XY, Zheng AnYuan ZA, Guo Yi GY. Characteristics of cigarette smoking without alcohol consumption and laryngeal cancer: overall and time-risk relation. A meta-analysis of observational studies. European Archives of Oto-Rhino-Laryngology 2016;274:1617-31. https://doi.org/10.1007/s00405-016-4390-x.

[10] Bassiony MA, Aqil M, Khalili M, Radosevich JA, Elsabaa HM. Tobacco consumption and oral, pharyngeal and lung cancers. Open Cancer J 2015;8:1-11. https://doi.org/10.2174/1874079001508010001.

[11] Yeo Y, Shin DW, Han K, Kim D, Kim TH, Chun S, Jeong SM, Song YM.Smoking, alcohol consumption, and the risk of thyroid cancer: A Population-Based Korean Cohort Study of 10 million people. Thyroid 2022;32:440-8. https://doi.org/10.1089/thy.2021.0675.

[12] Cho A, Chang Y, Ahn J, Shin H, Ryu S. Cigarette smoking and thyroid cancer risk: a cohort study. Br J Cancer 2018;119:638-45. https://doi.org/10.1038/s41416-018-0224-5.

[13] Lee JH, Chai YJ, Yi KH. Effect of cigarette smoking on thyroid Cancer: Meta-Analysis. Endocrinol Metab (Seoul) 2021;36:590-8. https://doi.org/10.3803/enm.2021.954.

[14] Flach S, Maniam P, Manickavasagam J. E-cigarettes and head and neck cancers: A systematic review of the current literature. Clin Otolaryngol 2019;44:749-56. https://doi.org/10.1111/coa.13384.

[15] Centers for Disease Control and Prevention (CDC). The National Health Interview Survey (NHIS). 2023. Available at: https://www.cdc.gov/nchs/nhis/index.htm. Accessed on: 10/01/2024.

[16] Wang X, Wang H, Zhang T, Cai L, Dai E, He J. Diabetes and its Potential Impact on Head and Neck Oncogenesis. J Cancer 2020;11:583-91. https://doi.org/10.7150/jca.35607.

[17] Seo JH, Kim YD, Park CS, Han KD, Joo YH. Hypertension is associated with oral, laryngeal, and esophageal cancer: a nationwide population-based study. Sci Rep 2020;10:10291. https://doi.org/10.1038/s41598-020-67329-3.

[18] Dhull AK, Atri R, Dhankhar R, Chauhan AK, Kaushal V. Major risk factors in head and neck Cancer: A Retrospective Analysis of 12-Year Experiences. World J Oncol 2018;9:80-4. https://doi.org/10.14740/wjon1104w.

[19] Barsouk A, Aluru JS, Rawla P, Saginala K, Barsouk A. Epidemiology, risk factors, and prevention of head and neck squamous cell carcinoma. Med Sci 2023;11:42. https://doi.org/10.3390/medsci11020042.

[20] Stanford-Moore G, Bradshaw PT, Weissler MC, Zevallos JP, Brennan P, Anantharaman D, Abedi-Ardekani B, Olshan AF. Interaction between known risk factors for head and neck cancer and socioeconomic status: the Carolina Head and Neck Cancer Study. Cancer Causes Control 2018;29:863-73. https://doi.org/10.1007/s10552-018-1062-8.

[21] Berthiller J, Straif K, Agudo A, Ahrens W, Bezerra dos Santos A, Boccia S, Cadoni G, Canova C, Castellsague X, Chen

C, Conway D. Low frequency of cigarette smoking and the risk of head and neck cancer in the INHANCE consortium pooled analysis. Int J Epidemiol 2015;45:835-45. https://doi.org/10.1093/ije/dyv146.

[22] Szukalska M, Szyfter K, Florek E, Rodrigo JP, Rinaldo A, Mäkitie AA, Strojan P, Takes RP, Suárez C, Saba NF, Braakhuis BJ. Electronic Cigarettes and Head and Neck Cancer Risk–Current state of art. Cancers 2020;12:3274. https://doi.org/10.3390/cancers12113274.

[23] Kulhánová I, Forman D, Vignat J, Espina C, Brenner H, Storm HH, Bauld L, Soerjomataram I. Tobacco-related cancers in Europe: The scale of the epidemic in 2018. Eur J Cancer 2020;139:27-36. https://doi.org/10.1016/j.ejca.2020.07.024.

[24] Nam IC, Park JO, Kim CS, Park SJ, Lee DH, Kim HB, Han K, Joo YH. Association of smoking status, duration and amount with the risk of head and neck cancer subtypes: a national population-based study. Am J Cancer Res 2022;12:4815. https://pubmed.ncbi.nlm.nih.gov/36381316/.

[25] Wilson C, Freitas CMT, Awan KH, Ajdaharian J, Geiler J, Thirucenthilvelan P. Adverse effects of E-cigarettes on head, neck, and oral cells: A systematic review. J Oral Pathol Med 2022;51:113-25. https://doi.org/10.1111/jop.13273.

[26] Lu Y, Sobue T, Kitamura T, Matsuse R, Kitamura Y, Matsuo K, Ito H, Oze I, Shimazu T, Yamaji T, Iwasaki M. Cigarette smoking, alcohol drinking, and oral cavity and pharyngeal cancer in the Japanese: a population-based cohort study in Japan. Eur J Cancer Prev 2018;27:171-9. https://doi.org/10.1097/cej.0000000000000283.

[27] Radoï L, Paget-Bailly S, Cyr D, Papadopoulos A, Guida F, Schmaus A, Cenee S, Menvielle G, Carton M, Lapôtre-Ledoux B, Delafosse P. Tobacco smoking, alcohol drinking and risk of oral cavity cancer by subsite. Eur J Cancer Prev 2013;22:268-76. https://doi.org/10.1097/cej.0b013e3283592cce.

[28] Nguyen H, Kitzmiller JP, Nguyen KT, Nguyen CD, Bui TC. Oral Carcinoma Associated with Chronic Use of Electronic Cigarettes. Otolaryngology 2017;7:304. https://doi.org/10.4172/2161-119x.1000304.

[29] Klawinski D, Hanna I, Breslin NK, Katzenstein HM, Indelicato DJ. Vaping the venom: oral cavity cancer in a young adult with extensive electronic cigarette use. Pediatrics 2021;147:e2020022301. https://doi.org/10.1542/peds.2020-022301.

[30] Zhang Y, Wang R, Miao L, Zhu L, Jiang H, Yuan H. Different Levels in Alcohol and Tobacco Consumption in Head and Neck Cancer Patients from 1957 to 2013. PLoS ONE 2015;10:e0124045. https://doi.org/10.1371/journal.pone.0124045.

[31] Czarnywojtek A, Warmuz-Stangierska I, Zdanowska J, Florek E, Zgorzlewicz M, Ruchała M, Stangierski A, Sowiński J. Smoking and thyroid disease--review of literature. Przeglad Lekarski 2009;66:878-81.

Received on October 16, 2024. Accepted on Aprile 29, 2026.

Correspondence: Zakaria Yahya Khawaji, Janadah Bin Umayyah Road, 42353, Tayba, Madinah, Saudi Arabia. E-mail: Zakaria.khawaji1@gmail.com.

How to cite this article: Sunyur AM, Alkhayat DS, Alahmadi MA, Mohammad HA, Abdullah S, Khawaji ZY, Badawi AS. Assessing the Association Between Head and Neck Cancers and Electronic Cigarette Use as Compared to Conventional Cigarette Use: Analysis of Results from National Health Interview Survey 2020-2022. J Prev Med Hyg 2026;67:E180-E187. https://doi.org/10.82082/2421-4248/jpmh2026.67.2.3424