OpenAccessPub

Journal of Public Health International

ISSN: 2641-4538

DOI: 10.14302/issn.2641-4538.jphi-22-4335

Research Article

Freely Available Online

The Risk of Oropharyngeal Cancer from E-Cigarette Use: An Urgent Public Health Concern

Cameron Y. S. Lee, DMD, MD, PHD, MPH, MSEd[1,2,3,*], Jon B. Suzuki, DDS, PHD, MBA[4]

[1]Private Practice in Oral, Maxillofacial and Reconstructive Surgery. Aiea, Hawaii 96701

[2]Clinical Professor of Surgery, Department of Periodontology/Oral Implantology

[3]Kornberg School of Dentistry. Temple University, Philadelphia, PA 19140.

[4]Professor Emeritus. Departments of Periodontology/Oral Implantology and Microbiology/Immunology. Temple University School of Dentistry and Medicine. Temple University. Philadelphia, PA 19140

Corresponding author: Cameron Y. S. Lee, Private Practice in Oral, Maxillofacial and Reconstructive Surgery. Aiea, Hawaii 96701, Clinical Professor of Surgery, Department of Periodontology/Oral Implantology, Kornberg School of Dentistry. Temple University, Philadelphia, PA 19140.

Keywords: tobacco cigarette, lung, head, neck, and oropharyngeal cancer

Received: Oct 03, 2022

Accepted: Oct 08, 2022

Published: Nov 04, 2022

Editor: Sasho Stoleski, Ss. Cyril and Methodius University, Faculty of Medicine Skopje, Macedonia

Abstract

It is estimated that over 47 million people use tobacco products, mostly in the form of combustible (smokable) tobacco cigarettes. Thirteen to 50% of smokers also use electronic cigarettes (also known as e-cigarettes or vaping). Use of tobacco is the primary preventable cause of death and risk factor for lung, head, neck, and oropharyngeal cancer. Electronic cigarettes are a $10 billion dollar industry and has the potential to surpass the tobacco cigarette market. E-cigarette use is a public health concern because of the health issues of vaping and the limited amount of scientific research to support the safety of e-cigarette use.

The authors of this paper want to create awareness that use of e-cigarettes is not a safer alternative to smoking tobacco cigarettes as e-cigarettes contain known carcinogens that may lead to development of oropharyngeal cancer.

Introduction

It is estimated that over 47 million people use tobacco products, mostly in the form of combustible (smokable) tobacco cigarettes.[1] Thirteen to 50% of smokers also use electronic cigarettes (also known as e-cigarettes or vaping).[2, 3] Use of tobacco is the primary preventable cause of death and risk factor for lung, head, neck, and oropharyngeal cancer.[4, 5] Cigarette smoke contains over seven hundred chemicals, including 60-70 known carcinogens. It is the combustible byproducts that lead to chronic tobacco-related disease and deaths after decades of smoking.[6] Compared to nonsmokers, the risk of developing lung cancer is twenty-five times greater. Cessation of smoking before age 40 decreases the risk of death by 90% from tobacco-related disease.[7]

Smoking is highest in adults aged 25- 64 years and it is estimated that 480,000 die annually from this social habit.[8] Oropharyngeal cancer is the sixth most common malignancy in the world.[9] The 5-year survival rate is approximately 75-83% due to high rates of recurrence with over 10,000 deaths per year in the United States.[10, 11] The prevalence is highest in the following groups: people of color, individuals of low income and low education level, persons on Medicaid, disability benefits, uninsured and those with depression and anxiety.[12]

Electronic cigarettes are a $10 billion dollar industry and has the potential to surpass the tobacco cigarette market.[13] E-cigarette use is a public health concern because of the health issues of vaping and the limited amount of scientific research to support the safety of e-cigarette use.[14]

The authors of this paper want to create awareness that use of e-cigarettes is not a safer alternative to smoking tobacco cigarettes, as e-cigarettes contain known carcinogens that may lead to development of oropharyngeal cancer.

Increase in E-Cigarette Use

Although cigarette smoking has deceased in younger age groups, e-cigarette use has steadily increased, especially students in middle (4.7 %) and high school (19.6%).[15] In 2019, greater than 5.3 million middle and high school students used e-cigarettes. The increase in vaping is propelled by an increase in marketing, the perceived perception that vaping is safer compared to tobacco cigarettes, introduction of new vaping devices that include prefilled cartridges and pods and the many flavors that are appealing in taste. Of the over 15,000 vaping flavor blends, menthol is one of the most popular flavors that is commonly found in peppermint, spearmint and other mint plants and is considered safe. It is used in cough drops, candy, and gums because of its cooling sensation to the oral cavity. Compared to tobacco cigarettes, menthol is found in higher concentrations in e-cigarettes and increases the nicotine effects increasing the risk of nicotine addiction and could be why students get addicted to vaping.[16]

Health Risk of Nicotine

Nicotine is the major addictive compound in tobacco.[17] Each inhalation of cigarette smoke from a cigarette delivers to the brain 1 mg of nicotine within 7 to 30 seconds.[18] Most of the inhaled nicotine is metabolized into continine which is non-carcinogenic. However, inhaled nicotine is also metabolized into nitrosamines which are potent carcinogens and cause DNA damage. [17] E-cigarettes contain higher amounts of nicotine compared to tobacco cigarettes and is the major component of e-cigarette smoke without having to burn tobacco. JUUL is the most common brand e-cigarette in the United States and each pod contains 5% (59mg/ml) nicotine.[19]

Nicotine is one of the main toxic substances in e-cigarettes and 45% released from vaping is deposited in the oral cavity.[20] Although there is no conclusive evidence that nicotine is involved in carcinogenesis in humans it has been shown that nicotine causes chromosomal abnormalities that results in DNA single strand breaks and mutations that could lead to cancer.[21, 22]

Association of Carcinogens and Oropharyngeal Cancer

Studies have shown that oral mucosa and epithelial cells of the oropharynx are the first tissue exposed to tobacco smoke and e-liquid aerosols from vaping. Chemical analysis of the components of e-cigarette aerosols has revealed the presence of many harmful environmental toxins and carcinogens such as organic compounds (e.g., formaldehyde, acetaldehyde, benzaldehyde, acetone), free radicals and heavy metals (copper, chromium, iron, lead, arsenic, lead, nickel).[23, 24, 25] In their study evaluating 225 e-liquid fluids, Lim and Shim [26] discovered the presence of formaldehyde, acetaldehyde and nitrosamines that are carcinogenic to the head and neck region. In a New Egland Journal of Medicine study, Jensen and colleagues[27] also discovered formaldehyde in aerosols during the vaping process. Yu et. al.[28] demonstrated that the vapors from e-cigarettes induced cell apoptosis resulting in cell death and DNA single strand breaks independent of the presence of nicotine. In another study by Flach and colleagues,[29] vaping liquid aerosols resulted in DNA double strand breaks that increases the risk of mutations and cancer. In a study on gene regulation and cell function of oral epithelial cells, Tommasi et. al.[30] observed dysregulation of genes involved in carcinogenic pathways. Based on these studies, the use of e-cigarettes is a risk factor for oropharyngeal cancer.

Conclusion

There is a paucity of studies of oropharyngeal cancer from e-cigarette use due to the long duration of carcinogenesis and the recent introduction of e-cigarettes. The authors clearly believe that this is an urgent public health issue as there will be an exponential increase in the number of cases of oropharyngeal cancer due to the known carcinogenic components in e-cigarettes over the next few decades.

Conflict of Interest

The authors report no conflict of interest with any products mentioned in this paper.

References

1. Cornelius ME, Loretan CG, Wang TW, et al. Tobacco product use among adults- United States 2020. MMWR Morb Mortal Wkly Rep 2022; 71: 397-405.
2. Douptcheva N, Gmel G, Studer J. et al. Use of electronic cigarettes among young Swiss men. J Epidemiol Community Health 2013; 67: 1075-1076.
3. Al Rifai M, Merchant AT, Nambi V, et al. Temporal trends in e-cigarette use among U.S. adults: Behavioral risk factor surveillance system, 2016-2018. Am J Med 2020; 133: e508-e511. Doi: 10.1016/j.amjmed.2019.12.020
4. Fox JL, Rosenzweig KE, Ostroff JS. The effect of smoking status on survival following radiation therapy for non-small cell lung cancer. Lung Cancer. 2004; 44: 287-293.
5. Cohen N, Fedewa S, Chen AY. Epidemiology and demographics of the head and neck cancer population. Oral Maxillofac Surg Clin North Am. 2018; 30: 381-395.
6. Zevin S, Benowitz NL. Drug interactions with tobacco smoking: an update. Clin Pharmacokinet 1999; 36: 425-438.
7. Jha P, Peto R. Global effects of smoking, of quitting, and of taxing tobacco. N Engl J Med 2014; 370: 60-68.
8. Office on Smoking and Health. The health consequences of smoking- 50 years of progress: a report of the Surgeon General. Atlanta: DHHS National Center for Chronic Disease Prevention and Health Promotion, 2014.
9. Warnakulasuriya S. Global epidemiology of oral and oropharyngeal cancer. Oral Oncol. 2009; 45: 309-316.
10. Lindenblatt RC, Martinez GL, Silva LE, et al. Oral squamous cell carcinoma grading systems- analysis of the best survival predictor. J Oral Pathol Med. 2012; 41: 34-39.

11. Radoi L Luce D. A review of risk factors for oral cavity cancer: the importance of a standardized case definition. Community Dent Oral Epidemiol. 2013; 41: 97-109, e78-e91.
12. Cornelius ME, Loretan CG, Wang TW, et al. Tobacco product use among adults- United States 2020. MMWR Morb Mortal Wkly Rep 2022; 71: 397-405.
13. McQueen N, Partington EJ, Harrington KF, et al. Smoking cessation and electronic cigarette use among head and neck cancer patients. Otolaryngol Head Neck Surg 2016; 154: 73-79.
14. National Academies of Sciences, Engineering and Medicine. Public health consequences of e-cigarettes; National Academies Press: Washington , DC, USA, 2018.
15. Wang TW, Neff IJ, Park-Lee E, et al. E-cigarette use among middle and high school students- United States, 2020. MMWR Morb Mortal Wkly Rep 2020; 69: 1310-1312.
16. Barrington-Trimis JL, Leventhal AM. Adolescents' of "pod mod" e-cigarettes- urgent concerns. N Engl J Med 2018; 379: 1099- 1102.
17. Benowitz NL. Pharmacology of nicotine: addiction, smoking-induced disease, and therapeutics. Annu Rev Pharmacol Toxicol 2009; 49: 57-71.
18. Brody AL, Mandelkern MA, London ED, et al. Cigarette smoking saturates brain alpha 4 beta 2 nicotinic acetylcholine receptors. Arch Gen Psychiatry 2006; 63: 907-915.
19. Morean ME, Bold KW, Kong G, et al. Adolescents' awareness of the nicotine strength and e-cigarette status of JUUL e-cigarettes. Drug and Alcohol Depend. 2019; 1;204: 107512. Doi: 10.1016/j.drugalcdep.2019.05.032.
20. Kumar P, Geisinger M, DeLong HR, et al. Living under a cloud: electronic cigarettes and the dental patient. JADA 2020; 151: 155-158.
21. Haussmann HJ, Fariss MW. Comprehensive review of epidemiological and animal studies on the potential carcinogenic effects of nicotine per se. Crit Rev Toxicol 2016; 46: 701- 734.
22. Sanner T, Grimsrud TK. Nicotine: Carcinogenicity and effects on response to cancer treatment- a review. Front Oncol 2015; 5:196. doi: 10.3389/fonc.2015.00196.
23. Cheng T. Chemical evaluation of electronic cigarettes. Tob Control 2014; 23 Suppl 2:ii 11-17.
24. Williams M, Bozhilov K, Ghail S, et al. Elements including metals in the atomizer and aerosol of disposable electronic cigarettes and electronic hookahs. PLoS One 2017; doi.org/10.1371/journal.pone.0175430.
25. Rubinstein ML, Delucchi K, Benowitz NL, et al. Adolescent exposure to toxic volatile organic chemicals from E-cigarettes. Pediatrics 2018; doi.org/10.1542/peds.2017-3557.
26. Lim HH, Shim HS. Measurement of aldehydes in replacement liquids of electronic cigarettes by headspace gas chromatography- mass spectrometry. B Korean Chem 2013; 34: 2691-2696.
27. Jensen RP, Luo W, Pankow JF, et al. Hidden formaldehyde in e-cigarette aerosols. N Engl J Med 2015; 372: 392=394.
28. Yu V, Rahimy Y, Korrapati A, et al. Electronic cigarettes induce DNA strand breaks and cell death independently of nicotine in cell lines. Oral Oncol 2016; 52: 58-65.
29. Flach S, Maniam P, Manickavasagam J. E-cigarettes and head and neck cancers: a systematic review of the current literature. Clin Otolaryngol. 2019; 44: 749-756. doi: 10.1111/coa.13384.
30. Tommasi S, Caliri AW, Caceres A, et al. Deregulation of biologically significant genes and associated molecular pathways in the oral epithelium of electronic cigarette users. Int J Mol Sci 2019; 20: 1-18.