**Summary Review**

**Title/Question:**

**Is there evidence that e-cigarettes promote an increased risk of dental caries?**

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**A Commentary on**

**Irusa KF, Finkelman M, Magnuson B, Donovan T, Eisen SE.** A comparison of the caries risk between patients who use vapes or electronic cigarettes and those who do not: A cross-sectional study. J Am Dent Assoc. 2022 Dec;153(12):1179-1183. doi: 10.1016/j.adaj.2022.09.013. PMID: 36435529.

**Abstract**

**Data Sources:** This study was conducted on a sample of patients who attended the dental clinic at Tufts University School of Dental Medicine, between January 1, 2019 and January 1, 2022. Ethical approval was obtained before commencing the research.

**Study selection:** This cross-sectional study was carried out through an electronic search of electronic records. It includes patients aged over 16 years, both electronic cigarette (e-cigarettes) users and non-users, with recorded caries risk assessments. Patients with a history of recreational drug use or lacking a caries diagnosis were excluded. The Caries Management by Risk Assessment (CAMBRA) was utilized to indicate and classify caries risk.

**Data extraction and synthesis:** Descriptive statistics, multivariate and bivariate analyzes were used to assess the relationship between use of e-cigarettes and caries risk level. SPSS software, Version 26 (IBM) was used in the analysis with significance level set at α =.05.

**Results:** Out of a total of 13,216 patients included in the research, 13,080 (99.3%) self-declared as non-users of e-cigarettes, and 136 (0.69%) were e-cigarette users. There was a statistically significant difference (P < 0.001) in caries risk levels between e-cigarette users (6.6% low, 14.3% moderate, and 79.1% high caries risk level) and control group (14.5% low, 25.9% moderate, and 59.6% high caries risk level).

**Conclusions:** The study provides evidence supporting the notion that e-cigarette users exhibit a high level of caries risk.

**GRADE Rating: Medium**

**Commentary**

 Electronic cigarettes (e-cigarettes) or vapes are electronic devices designed to heat a liquid (e-liquid) containing flavouring agents, such as propylene glycol, glycerin, and sometimes nicotine, producing an aerosol that users inhale.1 Electronic cigarettes have been promoted by manufacturers as a safe alternative for smoking cessation; however, their chemical components, variety of flavors, and nicotine are associated with the establishment of dependence and health risks for users.2 In this regard, the cariogenic potential of e-cigarettes has been associated with the aerosol's viscosity, presence of acids, and significant amounts of cariogenic sugars found in the flavouring agents. 1

 This study aimed to investigate the relationship between e-cigarette use and the risk level of dental caries.

 The research was conducted by examining electronic records of patients treated at Tufts University School of Dental Medicine's dental clinic between January 1, 2019, and January 1, 2022, with prior ethical approval. The study included patients aged over 16 years, encompassing both e-cigarette users and non-users, with recorded caries risk assessments. Patients with a history of recreational drug use or lacking a caries diagnosis were excluded from the study. The Caries Management by Risk Assessment (CAMBRA) tool was used to indicate and categorize the patients' caries risk into low, moderate, or high levels. The data analysis involved multivariate and bivariate analyses, utilizing the Mann-Whitney U test through SPSS software, Version 26 (IBM). The significance level set at α = 0.05.

 Mann-Whitney U test showed significantly lower caries levels in the control group compared to the e-cigarette or vape user group (P < 0.001). Within the control group, 14.5%, 25.9%, and 59.6% had low, moderate, and high caries risk levels, respectively, whereas the e-cigarette or vape user group exhibited 6.6%, 14.3%, and 79.1% in the corresponding risk categories. Interestingly, Vemulapalli et al. also reported an elevated risk of caries in e-cigarette users (OR=1.69; 95% CI: 1.24–2.29) compared to non-smokers. 3 Additionally, the combination of e-cigarettes with conventional cigarettes seemed to have a synergistic effect, increasing the propensity for untreated caries (OR=2.43; 95% CI: 1.36–4.36)..3

The review suggests that the increased risk of caries in users of e-cigarettes could be justified by an alteration of the oral microbiome, favoring the growth of *Streptococcus mutans* while, at the same time, inhibiting the growth of commensal species. The authors also indicated that data on the potential effect of e-cigarettes remains limited. However, there is a significant evidence suggesting that e-cigarettes act on all multifactorial aspects involved in the caries process. Dental caries can be conceptualized as a dynamic disease, multifactorial, biofilm-mediated, and sugar-driven, resulting in the phasic demineralization and remineralization of dental hard tissues. This concept can be taken to explain caries mediated by the use of e-cigarettes. Indeed, there is evidence, which suggest that propylene glycol and glycerin, components present in e-liquids, increase the viscosity of the aerosol, enhancing the adhesion, formation and stabilization of the biofilm, especially cariogenic forms such as *Streptococcus mutans*, while they suppress the growth of commensal species. 4,5 In addition, the flavorings present in e-cigarettes contains sucrose which can contribute to the sugar-driven mechanism related to dental caries by acidifying the environment, promoting the metabolism of cariogenic species, resulting into enamel demineralization.

 Entering into the multifactorial aspect of caries, the host represented by the teeth and saliva, along with time, act as two other important factors in this process. Addressing the multifactorial nature of caries, e-cigarettes negatively impact saliva's pH, buffering capacity, and immunoglobulin levels, reducing its antibacterial capacity. Consequently, the enamel demineralization promoted by e-cigarettes leads to a reduction in enamel surface hardness and the development of porosities, facilitating biofilm adhesion and formation. As a progressive chronic disease, dental caries accumulate over time, and continuous e-cigarette use, in a dose-dependent manner, exacerbates the long-term deleterious effects involved in the caries process.

 While the study provides statistically significant evidence linking e-cigarettes to an increased risk of developing caries, further research is required, including longitudinal studies, to establish the relationship between e-cigarettes and caries risk, as well as in-depth investigations exploring the influence of e-cigarettes on the oral microbiome, sugar-driven mechanisms, and dental structure. These studies will enhance our understanding of the potential oral health impacts of e-cigarette usage and inform preventive measures and policies for users and dental practitioners alike.

**References**

1 Fairchild R, Setarehnejad A. Erosive potential of commonly available vapes: a cause for concern? *Br Dent J* 2021; **231**: 487–491.

2 Kim SA, Smith S, Beauchamp C *et al.* Cariogenic potential of sweet flavors in electronic-cigarette liquids. *PLoS One* 2018; **13**: 1–22.

3 Vemulapalli A, Mandapati SR, Kotha A, Aryal S. Association between vaping and untreated caries: A cross-sectional study of National Health and Nutrition Examination Survey 2017-2018 data. *J Am Dent Assoc* 2021; **152**: 720–729.

4 Catala-Valentin A, Bernard JN, Caldwell M, Maxson J, Moore SD, Andl CD. E-Cigarette Aerosol Exposure Favors the Growth and Colonization of Oral Streptococcus mutans Compared to Commensal Streptococci. *Microbiol Spectr* 2022; **10**. doi:10.1128/spectrum.02421-21.

5 Rouabhia M, Semlali A. Electronic cigarette vapor increases Streptococcus mutans growth, adhesion, biofilm formation, and expression of the biofilm-associated genes. *Oral Dis* 2021; **27**: 639–647.

**Practice Points**

Dentists must proactively implement robust preventive and control measures to address the heightened risk of dental caries in e-cigarette users. Monitoring and follow-up for oral hygiene prophylactic measures are imperative, given the substantial biofilm growth observed in this population. Moreover, dental practitioners should be acutely aware of the concerning effects of e-cigarettes on enamel surface hardness, which may lead to the development of porosities and, consequently, raise the vulnerability to cracks, fractures, and potential tooth loss. Taking proactive measures and promptly addressing these dental concerns will be vital in safeguarding the oral health of e-cigarette users and promoting long-term dental well-being.