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ESSENTIAL DENTAL KNOWLEDGE

Does Vaping Increase the Risk of COVID-19 Transmission and Make Individuals Who Vape Susceptible to Infection and Prone to Severe Illness? A Review

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Cite this as: *J Can Dent Assoc* 2022;88:m1

ABSTRACT

The predominant mode of transmission of SARS-CoV-2 virus and coronavirus disease 2019 (COVID-19) is aerosols, and e-cigarettes/vaping products are a source of aerosols. There is a public health concern that the use of these products may increase the risk of COVID-19 transmission, susceptibility to COVID-19 and severity of the disease. Based on a review of existing literature, we found emerging evidence that suggests that people who vape are at higher risk of COVID-19, and, because of compromised lung function, their susceptibility to the disease and the severity of outcomes is increased. Aerosols generated by vaping products could be involved in the transmission of the virus when people are close to others who have been diagnosed with COVID-19 and are vaping. These findings may be useful to health care professionals, including dental professionals, in providing evidence to support informing patients about vaping and how the use of vaping products impacts the risk of COVID-19 transmission, infection susceptibility and severity of illness.

Published: January 18, 2022

Electronic cigarettes (e-cigarettes) or vaping products are battery-operated devices that electronically heat a solution to create an inhalable aerosol. They differ from regular cigarettes as they may contain nicotine but not tobacco, and they involve heating and production of aerosol but not burning and production of smoke.[1] The aerosol produced by these vaping devices contains propylene glycol, glycerol, flavours, carbonyl compounds, volatile organic compounds, metals and nicotine. A number of chemicals found in the aerosol produced by vaping devices have known toxicity (e.g., formaldehyde).[1] Independent of nicotine exposure, particulates and flavourings in e-cigarette/vape aerosols could also impair lung function.[2]

E-cigarettes/vaping devices were first introduced in the early 2000s and have evolved from resembling traditional cigarettes, to tank systems and other adaptations that look like everyday devices, such as USB sticks and pens. Although there are a variety of names for these types of devices, for the purposes of this paper, we use vaping product and vape to refer to all forms of battery-powered vaping devices or electronic nicotine delivery systems.

The negative effects of tobacco smoke on respiratory and overall health are well documented.[3] Although the health impacts (both short- and long-term) of vaping are less well established, evidence is emerging that it may affect susceptibility to respiratory infections and/or the ability to recover from them.[4,5] For example, vaping products are associated with lung injury.[6,7]

Studying vaping devices is a complex area of research because of the diverse designs and functions of these products and the ingredients used in them. Considering the potential harm of aerosols generated by vaping products for those using these products and for others through second-hand aerosol, a number of jurisdictions across the globe have restricted their use where smoking is also prohibited (e.g., enclosed public places and workplaces).[8-10]

On 11 March 2020, the World Health Organization declared COVID-19 a global pandemic. The predominant mode of transmission of the virus (SARS CoV 2) responsible for the disease is through aerosols or respiratory droplets during close unprotected contact.[11] The signs and symptoms of COVID-19 vary significantly, but respiratory illness is a prominent one. Older adults (≥ 60 years) and those with underlying health conditions are at increased risk of severe COVID-19.[12,13] For example, the Chinese Center for Disease Control and Prevention data show a fatality rate among people with chronic respiratory disease of 6.3% compared with 2.3% overall.[14]

The relation between vaping and COVID-19 is still largely unknown. If vaping is a confirmed risk factor for COVID-19 (i.e., it increases the chances of infection transmission, raises susceptibility to infection or increases the severity of illness), this may represent as a modifiable risk factor and an opportunity to take precautionary measures.

We examined the evidence relating use of vaping products to the risk of COVID-19. Specifically, we asked 2 important questions. Are people who use vaping products at a higher risk of contracting COVID-19 and/or experiencing more severe illness than those who do not use vaping products? Is there an increased risk of COVID-19 transmission through vaping products? We reviewed the existing literature to answer these questions.

Methods

On 1 Sept. 2020, Public Health Ontario Library Services conducted systematic searches in MEDLINE, Embase, CINAHL and Scopus, using relevant vocabulary and subject headings (e.g., COVID-19, SARS-CoV-2, e-cigarette, vaping, aerosol). Searches were limited to articles published in English in 2020.

We also conducted a search of the web sites of key organizations (e.g., World Health Organization and Centers for Disease Control and Prevention). As this is a rapidly evolving area, we included preprint literature, letters to the editor and commentaries. We also hand searched the bibliographies of included articles to identify relevant studies. Two reviewers (CD and SS) screened titles and abstracts, and then full-text versions of all papers that were included. Any need for clarification was discussed by the 2 reviewers. On 21 Sept. 2020, an updated search was conducted to identify any newly published material.

The library search identified 56 articles. Of these 56, 17 met inclusion criteria and are included in summary findings below.[15-19, 21-23,26-31,33,42,43] An additional 18 articles were included from the grey literature search, relevant PHO reports and hand-searching.[6,7,11,20,24,25,32,34-41,44-46]

Results

This is the first study to review the relation between vaping and COVID-19 in all important aspects: transmission, susceptibility and severity of infection.

Vaping and Susceptibility to and/or Severity of COVID-19

Although no studies directly measured the relation between vaping and increased risk of contracting COVID-19 or more severe illness, 30 articles discussed associations between vaping and COVID-19 susceptibility and/or severity of illness.[6,7,11,15-40]

COVID-19 Occurrence Associated with Vaping

Two population-based studies, both from the United States, have reported a relation between vaping and COVID-19: a cross-sectional survey and an ecological study.[22,23]

A national cross-sectional online survey of youth and young adults (ages 13–24 years) examined associations between vaping and COVID-19.[23] After adjusting for potential confounders, researchers found that COVID-19 diagnosis was 5 times more likely among ever users of vaping products only, 7 times more likely among ever dual-users of vaping products and tobacco cigarettes and 6.8 times more likely among past-30-days dual users compared with youth who had never vaped. The researchers concluded that COVID-19 is associated with youth use of vaping devices, whether solely or dually with tobacco cigarettes. They suggested a need for increased screening of youth and young adults for current use and a history of vaping. They also highlighted the importance of education in a variety of settings, such as schools, homes and community-based organizations to support learning among youth about the use of vaping products, dual use and the impact on respiratory and immune systems. This article highlights the need for robust longitudinal studies.

A pre-print study[22] indicated some jurisdictional-level correlation between vaping prevalence and the proportion of COVID-19 cases and associated deaths in the US. With every 1% increase in the weighted proportion of people who vape, there was an increase of 0.3139 (95% confidence interval [CI] 0.0554–0.5723) COVID-19 cases and 0.3705 (95% CI 0.0623–0.6786) COVID-19 deaths by log scale, in each US state. This study had some methodological limitations, including results based on aggregate data for a group, not asking participants about hospitalization or severity of symptoms, inability to establish asymptomatic respondents and basing solely on self-reported data. Thus, the study could not determine causality, but suggested plausibility of association.

Potential Role of Cell Receptors in COVID-19

Smoking is a predictor of a person's likelihood of developing a viral infection, especially a respiratory infection.[26,27] The angiotensin-converting enzyme 2 (ACE2) is the binding site for the virus causing COVID-19, facilitating its entry into the body.[11] Studies have found that nicotine (from smoking tobacco cigarettes) creates an increase in ACE2 expression in the body.[27,28] Given the affinity of COVID-19 for ACE2, these findings raise a concern that nicotine vaping products may also put users at a greater risk of COVID-19.[17,27-29] ACE2 levels have also been associated with increasing disease progression.[26,30]

Most studies on ACE2 and nicotine have been based on smoking tobacco. Although it has been suggested that there would be a similar result among those who use other tobacco and nicotine products, such as vapes, studies are needed to examine this hypothesis.[16,17,27-30]

Vaping and COVID-19 Susceptibility and Severity

Preliminary evidence suggests a potential role for smoking and/or vaping in COVID-19 susceptibility and severity.[33] Three review articles[17–19] highlighted that people who smoke/vape may be at higher risk of severe COVID-19 illness or the need for mechanical ventilation compared with non-smokers. It is hypothesized that the increased risk of contracting the disease and the eventual complications among those who smoke/vape are a result of delayed clearance of the virus.[17,18] People who smoke tobacco cigarettes and vape (dual use) are considered to be at increased risk of COVID-19 severe illness as they continue to be exposed to tobacco smoke.[32]

E-cigarette or vaping associated lung injury (EVALI) is an inflammatory response in the lungs triggered by inhaled substances.[6,7] EVALI was newly identified in North America in August 2019. Concerns have been raised of possible coexisting EVALI and COVID-19, as many EVALI symptoms are similar to those of COVID-19.[15,16] In the US, the footprint of the EVALI epidemic nearly mirrors that of current COVID-19 pandemic reported cases, thus matching regional social behaviour risk with current regional pandemic risk.[31] EVALI risk in the population who vape represents a possible increased risk of severe COVID-19 illness.[31]

Public health organizations and medical experts around the world are raising concerns that those who vape may be at a higher risk for COVID-19 susceptibility, severity and adverse outcomes.[34–40] More evidence is needed to determine the impact of vaping on the lungs and whether this impact increases a person's susceptibility to and severity of COVID-19.[15,16]

Vaping Products and COVID-19 Transmission

No studies were identified that directly measure the relation between vaping products and increased risk of COVID-19; however, 11 studies mentioned or identified associations between vaping and COVID-19 transmission suggesting the potential role of aerosols.[11,20,21,24,25,32,37,41–44] There is also evidence highlighting the potential role of aerosol transmission in other respiratory illnesses, such as Middle-East Respiratory Syndrome-associated coronavirus (MERS-CoV), Ebola virus and influenza.[45,46]

Aerosols and COVID-19 Transmission

The predominant mode of transmission of COVID-19 is via respiratory droplets during close unprotected contact.[11] Aerosols may be generated during medical procedures, which may increase the risk of transmission.[11] Therefore, it is plausible that the aerosols generated by vaping products may increase COVID-19 transmission.

A recent systematic review determined that most COVID-19 transmissions and clusters have been reported in indoor rather than outdoor settings.[42] One of the key risk factors noted in indoor settings was close proximity of people, reinforcing the importance of physical distancing as a control measure against COVID-19 transmission. However, overall risk of transmission depends on a variety of factors, such as ventilation, room occupancy (crowding, versus physical distancing), exposure time, face coverings for source control, type of activity (whether people are silent, speaking, shouting or singing) and interactions among these factors.[43,44] Understanding these factors can inform the precautions to take during the use of vaping products.

From the grey literature, although it is not known whether one can contract COVID-19 from vaping aerosol, the British Columbia Centre for Disease Control recommends that people stay 2m away from others while vaping and also vape outdoors to reduce the risk of infection transmission.[39] Public Health England also states that, although there is currently no evidence that COVID-19 can be transmitted from passive exposure to vaping product aerosol, it is recommended that people who are vaping avoid exhaling clouds of aerosol (often referred to as vapour) in the presence of others.[25]

Vaping Behaviour and COVID-19 Transmission

The act of vaping involves frequent hand-to-mouth contact, which may increase opportunities to contract COVID-19.[21,32] It is also common for those who vape to share devices and to vape in a group setting and/or confined spaces.[21] These practices increase the possibility of viral transmission from hand-to-mouth and through close contact with others.[11,21] Recent data from experimental studies have shown that the virus remains stable for several hours to days on surfaces, which makes it plausible for it to be transmitted via surfaces of vaping devices.[20]

From the grey literature, the World Health Organization (WHO) acknowledges the lack of direct evidence, at this time, about the relation between vaping and COVID-19. WHO suggests that, because COVID-19 affects the respiratory tract, the hand-to-mouth action of vaping may increase the risk of infection.[24] Public Health England has recommended that those who vape frequently wash their hands and clean devices regularly.[25] It also strongly advises against sharing any vaping devices.

Discussion

This review has some limitations. It includes studies published only in English; as the COVID-19 pandemic has been a global phenomenon, non-English studies might also have focused on this subject. Also, as the pandemic is rapidly evolving, it is difficult to keep pace with constantly emerging literature; therefore, studies published since 21 Sept. 2020 could not be part of this review.

Although limited, the existing literature on COVID-19 and aerosol/vaping provides sufficient evidence that aerosols, in general, pose an increased risk of COVID-19 transmission. That said, further research to understand the relation between vaping products and behaviours and the risk of COVID-19 transmission, susceptibility to and severity of illness would be insightful.

Until adequate evidence is available, the precautionary principle should be adopted to mitigate potential damage to lungs, susceptibility to infection and development of serious complications during the COVID-19 pandemic. In this endeavour, it is important that health care organizations provide explicit guidance about the potential harms of vaping in terms of COVID-19 transmission, infection susceptibility and severity of illness and how to use vaping products responsibly to prevent the spread of the virus. Health care organizations also play an integral role in reducing the risk among youth and young adults through prevention activities and supporting reduction and cessation among those who currently vape and/or smoke.

Conclusion

This synthesis of evidence will equip health care practitioners, including dental professionals, with a clearer understanding of the connections between vaping and COVID-19. In turn, these professionals can guide their patients more appropriately about potential risks. Also, this information will help policymakers and administrators build knowledge in the public about the affects of vaping on overall health and COVID-19 illness, as well as inform actions to reduce risks.

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Acknowledgements: We thank the library information specialists at Public Health Ontario for conducting literature searches in the relevant databases.

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The authors have no declared financial interests.

This article has been peer reviewed.

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