

Are e-cigarette users at greater risk of poor immune response to flu, COVID-19?

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In a controlled study of smokers, nonsmokers, and e-cigarette users, University of North Carolina School of Medicine researchers found that e-cigarette users exhibited significantly altered immune responses to a

model of influenza virus infection, suggesting increased susceptibility to disease.

The findings, published in the *American Journal of Respiratory Cell and Molecular Biology*, show that vaping changes the expression of genes and production of proteins in respiratory cells, as well as altering virus-specific antibody production.

"In many of the study participants, we observed more changes to the [immune response](#) in e-cigarette users than we did in smokers," said first author Meghan Rebuli, Ph.D., assistant professor in the UNC Department of Pediatrics and member of the UNC Center for Environmental Medicine, Asthma, and Lung Biology. "All of these factors have the potential to adversely affect response to a virus and immunity post-infection. While we used influenza as a model, this suggests that e-cigarette users are likely more susceptible to respiratory viruses than are non-smokers, and this likely includes SARS-CoV-2, the virus that causes [coronavirus](#) disease 2019 (COVID-19)."

The main reason to avoid smoking is the risk of cancer, heart disease, emphysema, stroke, diabetes, chronic obstructive pulmonary disorder, and other lung diseases. For these reasons, researchers also have been studying the potential effects of electronic cigarettes, which are composed of thousands of chemicals many of which are FDA-approved for ingestion, but not inhalation.

But for many years, inhalation of tobacco smoke has also been linked to increased risk of viral infection, such as influenza. Inhalation of e-cigarette aerosols has also been linked to immune suppression within the respiratory tract, specifically the protective mucosal layer lining the inside the [nasal cavity](#).

Rebuli, senior author Ilona Jaspers, Ph.D., and colleagues, thought that

changes in the nasal mucosal immune response could modify antiviral host defense responses in e-cigarette users. This is important because viruses, including the flu and SARS-CoV-2, have been shown to infect nasal cavities where they can replicate in cells, spread throughout the respiratory system, and be transmitted to other people. Jaspers, the director of the UNC Center for Environmental Medicine, Asthma, and Lung Biology, has led previous experiments showing that vaping altered hundreds of genes in [epithelial cells](#) involved in the body's natural immune defense. For the current study, the researchers wanted to study what happens when e-cigarette users are exposed to a respiratory virus.

For the study, non-smokers, cigarette smokers, and e-cigarette users, age 18-40, were inoculated with live attenuated influenza virus (LAIV) vaccine—a well-established model of influenza infection in the Jaspers lab—to safely examine innate immune response. Pre- and post-inoculation, the researchers collected nasal epithelial lining fluid, nasal lavage fluid, nasal scrape biopsies, urine, and blood. The scientists examined cytokines and chemokines, influenza-specific Immunoglobulin A (IgA), immune gene expression, and markers of viral load.

The researchers found that though the amount of markers of viral load did not differ among the three groups, expected increases in nasal epithelial lining fluid anti-LAIV IgA—which is a potential indicator of developed immunity post-infection—did not occur in e-cigarette users and cigarette smokers. Further, LAIV-induced gene expression changes in nasal biopsies differed in cigarette smokers and e-cigarette users as compared to non-smokers, with a greater number of genes changed in e-cigarette users, mostly resulting in decreased expression of immune genes critical for defense against viruses and generation of immune memory.

"This is not good," Jaspers said. "We want to see IgA levels increase during infection. It's the body's natural way to defend against an invader."

Here we saw that both smoking and e-cigarette use hampers IgA levels. The suppressed expression of important immune genes is also concerning and in line with an overall suppression of appropriate immune responses."

Moreover, altered immune response in [e-cigarette users](#) and cigarette smokers could make vaccines less effective in these groups.

"We don't know for sure if people who vape are more susceptible to COVID-19, or if vaccines would be less effective for them," Rebuli said. "But we know we never want to see suppression of genes, proteins, and antibodies involved in our immune response. And this is what we see in our data related to smoking and [e-cigarette](#) use."

More information: Meghan E Rebuli et al. E-cigarette Use Alters Nasal Mucosal Immune Response to Live-Attenuated Influenza Virus (LAIV), *American Journal of Respiratory Cell and Molecular Biology* (2020). [DOI: 10.1165/rcmb.2020-0164OC](https://doi.org/10.1165/rcmb.2020-0164OC)

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