

E-cigarette use can alter hundreds of genes involved in airway immune defense

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Credit: TheNorlo/Wikipedia

When we smoke cigarettes, dozens of genes important for immune defense are altered in the epithelial cells that line the respiratory tract. Several of these changes likely increase the risk of bacterial infections, viruses, and inflammation. Now, UNC School of Medicine scientists report that vaping electronic cigarettes alters those same genes and hundreds more that are important for immune defense in the upper

airway.

"I was really surprised by these results," said lead researcher Ilona Jaspers, professor of pediatrics, and microbiology and immunology at UNC. "That's why we kept going back to make sure this was accurate."

The finding, published in the *American Journal of Physiology*, suggests that inhaling the vaporized flavored liquids in [e-cigarettes](#) is not without consequences, at least on the level of epithelial cell gene expression - the critical process by which our [genes](#) give rise to proteins important for various functions in cells.

The discovery cannot yet be linked to long-term health effects of e-cigarette use or the risk of diseases usually associated with long-term cigarette smoking such as cancer, emphysema, or chronic obstructive pulmonary disease.

"We honestly do not yet know what long-term effects e-cigarettes might have on health," said Jaspers, senior author and director of UNC's toxicology curriculum. "I suspect that the effects of e-cigarettes will not be the same as the effects of cigarette smoking."

So far, though, the evidence suggests that long-term e-cigarette use will not be harmless.

E-cigarettes have only been on the market in the United States since 2006, and usage skyrocketed just a few years ago. The more than 7,000 flavors available in e-cigarettes are FDA approved, though that approval process was based on data generated for oral consumption, not inhalation.

To study what effects e-cigarettes have on genes that help our upper airways fight off potentially harmful pathogens, Jaspers' lab recruited 13

non-smokers, 14 smokers, and 12 e-cigarette users. Each participant kept a journal documenting their cigarette or e-cigarette use, and in collaboration with researchers from the University of California at San Francisco, Jaspers' team analyzed participant urine and blood samples to confirm nicotine levels and biomarkers relevant to tobacco exposure.

After about three weeks, researchers took samples from the nasal passages of each participant to analyze the expression of genes important for immune responses.

Visually and functionally, the epithelial layers of our nasal passages are very similar to the epithelial layers in our lungs. All [epithelial cells](#) along our airways - from our noses to the tiny bronchioles deep in our lungs - need to function properly to trap and dispatch particles and pathogens so we don't get sick. These epithelial cells are critical for normal immune defense. Certain genes in these cells must give rise to proper amounts of proteins, which orchestrate the overall [immune response](#). It has long been known that cigarette smoking modifies this gene expression, which is one reason researchers think smokers are more sensitive to upper respiratory problems.

Using the non-smokers as the baseline comparison group, Jaspers' team found that smoking cigarettes decreased the gene expression of 53 genes important for the immune response of epithelial cells. Using e-cigarettes decreased the [gene expression](#) of 358 genes important for [immune defense](#) - including all 53 genes implicated in the smoking group.

"We compared these genes one by one," Jaspers said, "And we found that each gene common to both groups was suppressed more in the e-cigarette group. We currently do not know exactly how e-cigarettes do this."

Jaspers said her lab's findings do not mean that smoking e-cigarettes is as

bad as or worse than smoking regular cigarettes

"I think it is a mistake to try to directly compare cigarette smoking and e-cigarette use," Jaspers said. "We shouldn't ask 'smoking causes cancer; do e-cigarettes cause cancer? Smoking causes emphysema; do e-cigarettes cause emphysema?'"

She said that inhaling burnt tobacco and inhaling vaporized flavored liquids are fundamentally different, and it's more likely that e-cigarettes could induce different biological changes and play different roles in other respiratory problems.

"We know that diseases like COPD, cancer, and emphysema usually take many years to develop in smokers," Jaspers said. "But people have not been using e-cigarettes for very long. So we don't know yet how the effects of e-cigarette use might manifest in 10 or 15 years. We're at the beginning of cataloging and observing what may or may not be happening."

Next, Jaspers will study how epithelial cells in e-cigarette users respond to a flu vaccine. This, she said, could help her team measure the immune response of epithelial cells in smokers, non-smokers, and e-cigarette users.

"We just finished our collection of samples," Jaspers said. "We'll see."

Provided by University of North Carolina Health Care

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