

Are e-cigarettes ‘safer’ than regular cigarettes?

UNC School of Medicine researchers lead new study showing that e-cigarettes trigger unique and potentially damaging immune responses in human airways.

October 20, 2017

CHAPEL HILL – E-cigarettes appear to trigger unique immune responses as well as the same ones triggered by regular cigarettes, according to new research published online in the American Thoracic Society’s **American Journal of Respiratory and Critical Care Medicine.**



Immune responses are the biological reactions of cells and fluids to an outside substance the body doesn’t recognize as its own. Such immune responses play roles in disease, including lung disease spurred on by cigarette use.

Mehmet Kesimer, PhD, senior author and associate professor of pathology and laboratory medicine at the UNC School of Medicine, and coauthors report findings from what is believed to be the first study of the harmful effects of e-cigarettes using sputum samples from human lungs.

“There is confusion about whether e-cigarettes are ‘safer’ than cigarettes because the potential adverse effects of e-cigarettes are only beginning to be studied,” said Kesimer, who is also a member of the UNC Marsico Lung Institute. “This study looked at possible biomarkers of harm in the lungs. And our results suggest that in some ways using e-cigarettes could be just as bad as smoking cigarettes.”



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Mehmet Kesimer, PhD

A 2016 Surgeon General's report found that e-cigarette use has increased by 900 percent among high school students from 2011 to 2015. Also in 2016, the Food and Drug Administration extended its regulatory oversight of tobacco products to include e-cigarettes.

The study compared sputum samples from 15 e-cigarette users, 14 current cigarette smokers and 15 non-smokers. They found e-cigarette users uniquely exhibited significant increases in:

- Neutrophil granulocyte- and neutrophil-extracellular-trap (NET)-related proteins in their airways. Although neutrophils are important in fighting pathogens, left unchecked neutrophils can contribute to inflammatory lung diseases, such as COPD and cystic fibrosis.
- NETs outside the lung. NETs are associated with cell death in the epithelial and endothelium, the tissues lining blood vessels and organs. The authors write that more research is necessary to determine if this increase is associated with systemic inflammatory diseases, such as lupus, vasculitis, and psoriasis.

The study also found that e-cigarettes produced some of the same negative consequences as cigarettes. Both e-cigarette and cigarette users exhibited significant increases in:

- Biomarkers of oxidative stress and activation of innate defense mechanisms associated with lung disease. Among these biomarkers are aldehyde-detoxification and oxidative-stress-related proteins, thioredoxin (TXN) and matrix metalloproteinase-9 (MMP9).
- Mucus secretions, specifically mucin 5AC, whose overproduction has been associated with pathologies in the lung including chronic bronchitis, bronchiectasis, asthma, and wheeze.

Study limitations include the fact that of the 15 e-cigarette users, five said they occasionally smoked cigarettes and 12 identified themselves as having smoked cigarettes in the past.

“Comparing the harm of e-cigarettes with cigarettes is a little like comparing apples to oranges,” Kesimer said. “Our data shows that e-cigarettes have a signature of harm in the lung that is both similar to what we see in cigarette smokers and unique in other ways. This research challenges the concept that switching to e-cigarettes is a healthier alternative.”

In an unrelated study last year, Ilona Jaspers, PhD, professor of pediatrics, and microbiology and immunology at the UNC School of Medicine, **studied the effects of vaping on genes.** When we smoke cigarettes, dozens of genes important for immune defense are altered in the epithelial cells that line the nasal mucosa. Several of these changes likely increase the risk of bacterial infections, viruses, and inflammation. Jaspers' lab found that vaping alters the same genes affected during cigarette smoking and hundreds of other genes important for immune defense in the nasal, upper airway.

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The National Institutes of Health and the Food and Drug Administration Center for Tobacco Products funded this research. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH or the FDA.

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