

Similar DNA changes found in cells of both smokers and e-cigarette users

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E-cigarette users with a limited smoking history experience similar DNA changes to specific cheek cells as smokers, finds a new study led by researchers at UCL (University College London) and University of

Innsbruck.

This study is an incremental step in helping researchers to build a deeper understanding of the long-term effects of e-cigarettes on health.

Although it does not show that e-cigarettes cause cancer, studies with long-term follow up are important to assess whether e-cigarettes have harmful effects and, if so, what they are.

The study, published in *Cancer Research*, analyzed the epigenetic effects of tobacco and e-cigarettes on DNA methylation in over 3,500 samples, to investigate the impact on cells that are directly exposed to tobacco (e.g., in the mouth) and those that are not directly exposed (e.g., in blood or cervical cells).

The epigenome refers to an extra layer of information that is superimposed on our genetic material—the DNA. While DNA can be compared to the hardware of a computer, epigenetics are comparable to the computer's software, and define how, where and when the programs used by the computer are run.

Epigenomes change throughout our lives and can be affected by a variety of genetic or nongenetic factors—including aging, our lifestyles, exposure to hormones, chemicals and environmental factors, and even stress and psychological trauma. One commonly studied type of epigenetic modification is called DNA methylation.

The researchers found that [epithelial cells](#) (cells that typically line organs and are often the cells of origin for cancer) in the mouth showed substantial epigenomic changes in smokers. Importantly, these changes are further elevated in lung cancers or pre-cancers (abnormal cells or tissue that have the potential to develop into cancer), when compared to the normal lung tissue, supporting the idea that the epigenetic changes associated with smoking allow cells to grow more quickly.

The publication also includes new data showing the similar epigenomic changes were likewise observed in the cells of [e-cigarette users](#) who had only ever smoked less than 100 tobacco cigarettes in their lives.

First author, Dr. Chiara Herzog (UCL EGA Institute for Women's Health and University of Innsbruck), said, "This is the first study to investigate the impact of smoking and vaping on different kinds of cells—rather than just blood—and we've also strived to consider the longer-term health implications of using e-cigarettes.

"We cannot say that e-cigarettes cause cancer based on our study, but we do observe e-cigarette users exhibit some similar epigenetic changes in buccal cells as smokers, and these changes are associated with future lung cancer development in smokers. Further studies will be required to investigate whether these features could be used to individually predict cancer in smokers and e-cigarette users.

"While the scientific consensus is that e-cigarettes are safer than smoking tobacco, we cannot assume they are completely safe to use and it is important to explore their potential long-term risks and links to cancer. We hope this study may help form part of a wider discussion into e-cigarette usage—especially in people who have never previously smoked tobacco."

Through their computational analysis of the samples, the researchers also found that some smoking-related epigenetic changes remain more stable than others after giving up smoking, including smoking-related epigenetic changes in cervical samples—something that has not previously been studied.

Senior author, Professor Martin Widschwendter (UCL EGA Institute for Women's Health and University of Innsbruck), said, "The epigenome allows us, on one side, to look back. It tells us about how our body

responded to a previous environmental exposure like smoking. Likewise, exploring the epigenome may also enable us to predict future health and disease. Changes that are observed in lung cancer tissue can also be measured in cheek cells from smokers who have not (yet) developed a cancer.

"Importantly, our research points to the fact that e-cigarette users exhibit the same changes, and these devices might not be as harmless as originally thought. Long-term studies of e-cigarettes are needed. We are grateful for the support the European Commission has provided to obtain these data."

Tobacco is well known as a modifiable contributor to adverse health outcomes, and it has been estimated to have caused 7.69 million deaths globally in 2019, with numbers expected to increase in the future. The NHS says e-cigarettes are substantially safer than smoking tobacco and smokers are recommended to switch to vaping to improve their health.

The researchers involved in the latest study now hope to further investigate how epigenetic changes related to smoking in cheek swabs could be used for identifying individuals at highest risk of developing cancer and assess the long-term health risks of e-cigarettes.

Dr. Ian Walker, Cancer Research UK's executive director of policy, said, "This study contributes to our understanding of e-cigarettes, but it does not show that e-cigarettes cause cancer. Decades of research has proven the link between smoking and cancer, and studies have so far shown that e-cigarettes are far less harmful than smoking and can help people quit. This paper does, however, highlight that e-cigarettes are not risk-free, and so we need additional studies to uncover their potential longer-term impacts on human health.

"Smoking tobacco causes 150 cases of cancer every single day in the

UK, which is why we look forward to seeing the Government's age of sale legislation being presented in parliament. Nothing would have a bigger impact on reducing the number of preventable deaths in the UK than ending [smoking](#), and this policy will take us one step closer to a smoke-free future."

More information: DNA methylation changes in response to cigarette smoking are cell-and exposure-specific and indicate shared carcinogenic mechanisms with e-cigarette use, *Cancer Research* (2024). [DOI: 10.1158/0008-5472.CAN-23-2957](#)

Provided by University College London

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