

Except for this research, nearly all other studies have focused on nicotine. The cellular culprit can be verified as polyethylene glycol, a hyperosmotic in e-cigarettes and diacetyl and other hyperosmotics that are used for flavorings. Studies relative to flavored e-cigarettes, establish severe increases in CV risk associated with flavorings.

That factor makes e-cigarettes a nearly unimaginable public health hazard.

<https://medicalxpress.com/news/2018-07-e-cigarettes-cardiovascular-cigarettes.html>

## New study finds that e-cigarettes increase cardiovascular risk as much as cigarettes

July 9, 2018, SAGE Publications

The usage of e-cigarettes containing nicotine has a significant impact on vascular functions claims new study. Research published in the SAGE journal, *Vascular Medicine*, has brought new research to light on the significant health risks of e-cigarettes with nicotine. The study revealed that smokers of e-cigarettes experienced the same, if not higher level of cardiovascular elevation for prolonged periods after smoking the e-cigarette. The findings have significant implications for our understanding of the use of e-cigarettes on long-term cardiovascular risk.

Conducted by Franzen et al., results were obtained by monitoring participant's vitals during and after they had smoked a cigarette, e-cigarette, or **nicotine-free e-cigarette**. The smoking lasted for one cigarette, at least 5 minutes, and the vaping lasted for one session for 5 minutes. Vitals were monitored for 2 hours from when smoking commenced.

Researchers found that using e-cigarettes and cigarettes, in comparison to nicotine-free e-cigarettes, had the same significant impact on vitals, with participant's blood pressure and heart rate being affected. Peripheral systolic blood pressure was raised significantly for 45 minutes after using an e-cigarette and 15 minutes after smoking a cigarette. Heart rate also remained elevated for 45 minutes for e-cigarettes, with the increase being higher than 8% for the first 30 minutes. In comparison, traditional cigarettes only raised heart rate for 30 minutes and there was again no change when using nicotine-free e-cigarettes. Franzen et al. use this data to state that the e-cigarettes can be as dangerous as cigarettes, simply concluding that:

"The increased parameters within the nicotine containing devices might be a link to an increased cardiovascular risk which is well known for cigarettes."

As one of the first trials studying blood pressure and heart rate elevation in relation to e-cigarette use, the authors emphasized the need for further studies in the area, stating: "Future trials should focus on chronic effects of vaping nicotine-containing or nicotine free liquids on peripheral and central blood pressures as well as on arterial stiffness. Since no endothelial dysfunction nor gender differences were described for three different arms in literature, it would be important for future trials to address these items."

Along with highlighting further areas of discussion the study has provided clear evidence of the potential cardiovascular issues from acute e-cigarette use and diminishes the common thought that e-cigarettes are a lower risk than tobacco products.

**Explore further: FIRS: guidance offered for protecting youth from e-cigarettes**  
**More information:** Klaas Frederik Franzen et al, E-cigarettes and cigarettes worsen peripheral and central hemodynamics as well as arterial stiffness: A randomized, double-blinded pilot study, *Vascular Medicine* (2018). DOI: 10.1177/1358863X18779694

**Journal reference:** Vascular Medicine

Epigenetic assessment of the products contained in e-cigarettes identified polyethylene glycol (PEG) as a major public health hazard due to its hyperosmotic properties. The following is provided to explain the impact on cells that can form defensive barriers; e.g. those that line the lungs.

<http://www.mcfip.net/upload/Hyperosmotics%20-%20Chronic%20Disease%20Factors.pdf>

<https://medicalxpress.com/news/2018-06-flavored-electronic-cigarettes-linked-cardiovascular.html>

## **Tobacco aside, e-cigarette flavorings may harm blood vessels**

June 14, 2018, American Heart Association

Flavor additives used in electronic cigarettes and related tobacco products could impair blood vessel function and may be an early indicator of heart damage, according to new laboratory research in *Arteriosclerosis, Thrombosis and Vascular Biology*, an American Heart Association journal.

The health effects of "combustible" tobacco products including traditional cigarettes and hookah are well-established, but the potential dangers of e-cigarettes have not yet been extensively studied. E-cigarettes are battery-powered devices that heat a liquid—including tobacco-derived nicotine, flavoring and other additives—and produce an aerosol that is inhaled.

Nine chemical flavorings—menthol (mint), acetylpyridine (burnt flavor), vanillin (vanilla), cinnamaldehyde (cinnamon), eugenol (clove), diacetyl (butter), dimethylpyrazine (strawberry), isoamyl acetate (banana) and eucalyptol (spicy cooling) - which are widely used in e-cigarettes, hookah, little cigars and cigarillos were tested for their short-term effects on endothelial cells, the cells which line the blood vessels and the inside of the heart.

Researchers found all nine flavors were dangerous to cells in the laboratory at the highest levels tested and all the flavorings impaired nitric oxide production in endothelial cells in culture (outside of the body). Several of the flavorings—menthol, clove, vanillin, cinnamon and burnt flavoring—resulted in higher levels of an inflammatory marker and lower levels of nitric oxide, a molecule that inhibits inflammation and clotting, and regulates vessels' ability to widen in response to greater blood flow.

"Increased inflammation and a loss of nitric oxide are some of the first changes to occur leading up to cardiovascular disease and events like heart attacks and stroke, so they are considered early predictors of heart disease," said lead study author Jessica L. Fetterman, Ph.D., assistant professor of medicine at Boston University School of Medicine in Massachusetts. "Our findings suggest that these flavoring additives may have serious health consequences."

Endothelial cells were collected from volunteers (nine non-smokers/non-e-cigarette users; six non-menthol and six menthol cigarette smokers) and tested in the lab. Researchers found that both groups of smokers had a similar deficit in nitric oxide production when stimulated by a chemical called A23187. Nonsmokers' cells that were treated with menthol or a clove flavoring also had impaired nitric oxide production, suggesting those flavorings cause damage like that found in active smokers.

The team also exposed commercially-available human aortic endothelial cells to the flavorings. Burnt flavor, vanilla, cinnamon and clove flavors impaired nitric oxide production and boosted an inflammatory chemical called interleukin-6 (IL-6) at all concentrations tested, suggesting the endothelium is particularly sensitive to these flavors.

Menthol applied to the cells increased IL-6 at high concentrations and reduced nitric oxide even at low doses. In smokers, scientists don't see differences in heart disease between menthol and non-menthol users—probably because cigarette smoke is overwhelmingly toxic, Fetterman said. "But menthol is certainly not a benign player, based upon our work."

At the highest levels tested, all nine chemicals caused cell death, while at lower levels cinnamon, clove, strawberry, banana and spicy cooling flavor did.

Dimethylpyrazine/strawberry flavor had that effect even at very low levels, suggesting endothelial cells are especially sensitive to it. Vanillin and eugenol also increased oxidative stress in the cells.

Three flavorings were tested when heated, to mimic what happens in e-cigarettes. Nitric oxide production was impaired with vanillin and eugenol, but not with menthol.

"Our work and prior research have provided evidence that flavorings induce toxicity in the lung and cardiovascular systems. Flavorings are also a driver of youth tobacco use and sustained tobacco use among smokers," Fetterman said.

A key strength of the new research was that it directly tested effects of just the flavorings, at levels likely to be reached in the body. Limitations include the fact that testing did not heat all the flavorings or include other chemicals used in e-cigarettes. Also, the study gauged just the flavorings' short-term effects and captured these with cells outside the body, not inside.

"We still don't know what concentrations of the flavorings make it inside the body," Fetterman said.

Most adult e-cigarette users are current or former combustible cigarette smokers who may use e-cigarettes as an aid in smoking cessation or as a harm-reduction tool. In addition, e-cigarette use by youth is rising rapidly with 37 percent of high schoolers reporting they have had an e-cigarette in 2015. Flavored tobacco products are a major driver of experimentation among youth.

The American Heart Association cautions against the use of e-cigarettes, stating that e-cigarettes containing nicotine are tobacco products that should be subject to all laws that apply to these products. The Association also calls for strong new regulations to prevent access, sales and marketing of e-cigarettes to youth, and for more research into the product's health impact.

**Explore further:** [E-cigarette flavors are toxic to white blood cells, warn scientists](#)

**More information:** *Arteriosclerosis, Thrombosis and Vascular Biology* (2018). DOI: 10.1161/ATVBAHA.118.311156

**Journal reference:** [Arteriosclerosis, Thrombosis and Vascular Biology](#)

Using bioinformatic search, the substances used to add flavors to e-cigarettes can be independently verified as being hyperosmotic. In other words, they increase the potential to disrupt defensive cell barriers. Furthermore, a similar search method will identify menthol, cinnamaldehyde and diacetyl as inhibiting calcium influx into cells. The remaining substances can be verified as increasing calcium influx. The following links are provided to explain the role of calcium in maintain cellular health.

<http://www.mcfip.net/upload/Optimal%20Example%20-%20Causes%20of%20Chronic%20Diseases.pdf>

<https://www.sciencedaily.com/releases/2016/10/161011182621.htm>

Mention of changes in the levels of nitric oxide levels from these substances is critically important because the lining of the vasculature (tunica intima) is comprised of endothelial cells that produce nitric oxide and the middle layer (tunica media) is comprised of smooth muscle cells that produce hydrogen sulfide. It is an easily verifiable fact that nitric oxide is a vasodilator and hydrogen sulfide is a vasoconstrictor. Accordingly, any changes in the ratio between these two gasotransmitters could result in a heart attack.

Also, the flavorings outlined in the article are used in many other instances in the food chain; i.e. not merely with e-cigarettes. Accordingly, in a dose dependent manner, these substances can increase risks to cellular health in the body.

## Summary

Review of the facts associated with e-cigarettes establishes serious public health risks for damage to the lungs and the vasculature.