

Aerosol from a wide range of vaping devices negatively impacts blood vessel function

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Aerosol generated from vaping devices likely impairs blood vessels' ability to function comparable to traditional cigarette smoke, according to preliminary research in rats presented at the American Heart Association's Basic Cardiovascular Sciences Scientific Sessions 2021.

Vaping, or the use of e-cigarettes, is often promoted as a less harmful alternative to smoking traditional cigarettes. E-cigarettes contain a cartridge with a liquid containing nicotine that generates an aerosol that is inhaled, like smoking a cigarette. Despite the popularity of these devices, knowledge is still limited about the impact of the aerosols from e-cigarettes, heated [tobacco products](#) and newer, coil-less, ultrasonic vaping devices on cardiovascular function.

"When you inhale a suspension of particles or a mist, whether it is from tobacco or marijuana, whether it's smoke or aerosol, it all has the same effect," said Matthew L. Springer, Ph.D., senior author of the study and a professor of medicine at the University of California, San Francisco School of Medicine. "Our research reinforces the previous

findings that vaping is not without harm, and it underscores the importance of counseling patients about the risks of vaping because it does affect [cardiovascular function](#)."

Researchers investigated the impact of aerosols generated from a range of vaping devices on the function of the endothelium, which is a thin membrane lining the inside of the heart and blood vessels. The endothelium is a layer of endothelial cells that produce substances that help control blood clotting, blood pressure levels and immune function and help keep [blood vessels](#) healthy. Reduced endothelial function usually precedes the development of atherosclerosis, the build-up of fatty material on arteries, and it is often a predictor of a stroke or heart attack.

In this study, a process known as flow-mediated dilation (FMD), an indicator of endothelial function and overall blood vessel health, was measured by ultrasound. FMD was measured in the rats before and after exposure to the aerosols from each of these:

- propylene glycol (PG),
- vegetable glycerin (VG),
- propylene glycol and vegetable glycerin (PGVG),
- 5% nicotine salt pods of three different flavors (Virginia tobacco, mango and menthol),
- an e-cigarette with free-base nicotine (a previous-generation vaping product),
- a "heat-not-burn" tobacco product, and
- a coil-less ultrasonic vaping device.

Combustible cigarette smoke and clean air were the controls for the study. The researchers sought to determine if aerosols from the different vaping products—regardless of flavor, nicotine amount or method of delivery—diminished blood vessel function. They performed a head-to-head comparison on 11 groups of rats with eight rats in

each group, exposing the rats to the nine vaping products, as well as the controls of combustible cigarettes and clean air. The rats were exposed to the products during one session consisting of 10 cycles of 5-second inhalation every 30 seconds over a five-minute period. To measure FMD, the femoral artery, a large artery in the thigh, was measured with a micro-ultrasound.

The study found:

- After only one five-minute session of exposure, endothelial function in the rats was acutely impaired by aerosols from all vaping products. Vessel dilation fell between 40% and 67% for all groups except the rats exposed to the clean air.
- This blood vessel impairment in vaping products was comparable to the impairment caused by traditional cigarettes (67%).

The researchers also collected blood from the rats to measure nicotine concentration. They found that the blood-nicotine concentration was 8.7 times higher in the rats exposed to the heated tobacco product (average of 61.4 ng/ml) than in the rats exposed to the ultrasonic vaping device (average of 7.0 ng/ml) and 7.3 times higher than the previous generation of e-cigarette (average of 8.4 ng/ml).

"We were not surprised when we saw the results for the heated tobacco products and previous generation e-cigarettes, however, we were somewhat surprised to discover that the new ultrasonic [vaping](#) device also impaired flow-mediated dilation," said study lead author Poonam Rao, M.D., a postdoctoral fellow at the Center for Tobacco Control Research and Education at the University of California, San Francisco. "This new ultrasonic device has no heating coil, so theoretically it should be safer than e-cigarettes. Yet even without the intense heating of the nicotine substance, this aerosol impaired vascular function like all of the other products."

While these results are from an animal experiment, they are applicable to humans. "The approach we used to study vascular function in the rats closely resembles what happens in humans. This is a rodent-equivalent of a common clinical measure in

humans in the brachial artery, the major blood vessel of the (upper) arm," Springer said. "It is known that [e-cigarettes](#) can impair vascular function in humans. If any mist or aerosol that rats inhale has this adverse effect, it will likely happen in humans, too."

Co-authors are Kelly Tan; Daniel D. W. Han, B.A.; and Ronak Derakhshandeh, M.Sc. Author disclosures are in the abstract. The study was funded by the U.S. Food and Drug Administration, the National Institutes of Health and the Elfenworks Foundation.

More information: [Conferecne: professional.heart.org/en/meet ... diovascular-sciences](#)

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