Studies Show Damaging Effects of Vaping, Smoking on Blood Cessels

Combining e-cigarettes with regular cigarettes may increase health risks.

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Long-term use of electronic cigarettes, or vaping products, can significantly impair the function of the body's blood vessels, increasing the risk for cardiovascular disease. Additionally, the use of both e-cigarettes and regular cigarettes may cause an even greater risk than the use of either of these products alone. These findings come from two new studies supported by the National Heart, Lung, and Blood Institute (NHLBI), part of the National Institutes of Health (NIH).

The findings, which appear today in the journal Arteriosclerosis, Thrombosis, and Vascular Biology, add to growing evidence that long-term use of e-cigarettes can harm a person's health. Researchers have known for years that tobacco smoking can cause damage to blood vessels. However, the effects of e-cigarettes on cardiovascular health have been poorly understood. The two new studies – one on humans, the other on rats – aimed to change that.

"In our human study, we found that chronic e-cigarettes users had impaired blood vessel function, which may put them at increased risk for heart disease," said Matthew L. Springer, PhD, a professor of medicine in the Division of Cardiology at the University of California in San Francisco, and leader of both studies. "It indicates that chronic users of e-cigarettes may experience a risk of vascular disease similar to that of chronic smokers."

In this first study, Springer and his colleagues collected blood samples from a group of 120 volunteers that included those with long-term e-cigarette use, long-term cigarette smoking, and those who didn't use. The researchers defined long-term e-cigarette use as more than five times/week for more than three months and defined long-term cigarette use as smoking more than five cigarettes per day.

They then exposed each of the blood samples to cultured human blood vessel (endothelial) cells in the laboratory and measured the release of nitric oxide, a chemical marker used to evaluate proper functioning of endothelial cells. They also tested cell permeability, the ability of molecules to pass through a layer of cells to the other side. Too much permeability makes vessels leaky, which impairs function and increases the risk for cardiovascular disease.

The researchers found that blood from participants who used e-cigarettes and those who smoked

caused a significantly greater decrease in nitric oxide production by the blood vessel cells than the blood of nonusers. Notably, the researchers found that blood from those who used e-cigarettes also caused more permeability in the blood vessel cells than the blood from both those who smoked cigarettes and nonusers. Blood from those that used e-cigarettes also caused a greater release of hydrogen peroxide by the blood vessel cells than the blood of the nonusers. Each of these three factors can contribute to impairment of blood vessel function in people who use e-cigarettes, the researchers said.

In addition, Springer and his team discovered that e-cigarettes had harmful cardiovascular effects in ways that were different from those caused by tobacco smoke. Specifically, they found that blood from people who smoked cigarettes had higher levels of certain circulating biomarkers of cardiovascular risks, and the blood people who used e-cigarettes had elevated levels of other circulating biomarkers of cardiovascular risks.

“These findings suggest that using the two products together, as many people do, could increase their health risks compared to using them individually,” Springer said. “We had not expected to see that.”

In the second study, the researchers tried to find out if there were specific components of cigarette smoke or e-cigarette vapor that were responsible for blood vessel damage. In studies using rats, they exposed the animals to various substances found in tobacco smoke or e-cigarettes. These included nicotine, menthol (a cigarette additive), the gases acrolein and acetaldehyde (two chemicals found in both tobacco smoke and e-cigarette vapors), and inert carbon nanoparticles to represent the particle-like nature of smoke and e-cigarette vapor.

Using special arterial flow measurements, the researchers demonstrated that blood vessel damage does not appear to be caused by a specific component of cigarette smoke or e-cigarette vapor. Instead, they said, it appears to be caused by airway irritation that triggers biological signals in the vagus nerve that somehow leads to blood vessel damage, possibly through an inflammatory process. The vagus is a long nerve extending from the brain that connects the airway to the rest of the nervous system and plays a key role in heart rate, breathing, and other functions. The researchers showed that detaching the nerve in rats prevented blood vessel damage caused by tobacco smoke, demonstrating its key role in this process.

“We were surprised to find that there was not a single component that you could remove to stop the damaging effect of smoke or vapors on the blood vessels,” Springer said. “As long as there’s an irritant in the airway, blood vessel function may be impaired.”

The finding has implications for efforts to regulate tobacco products and e-cigarettes, as it underscores how difficult it is to pinpoint any one ingredient in them that is responsible for blood vessel damage. “What I like to tell people is this: Just breathe clean air and avoid using these products,” Springer said.

Lisa Postow, Ph.D., an NHLBI program officer in NHLBI’s Division of Lung Diseases, agreed that the study results “provide further evidence that exposure to e-cigarettes could lead to harmful

cardiovascular health effects.” She added that more data is needed to fully understand the health effects of e-cigarettes. The NIH and others are continuing to explore this area.

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