Electronic cigarettes require more suction than conventional brands

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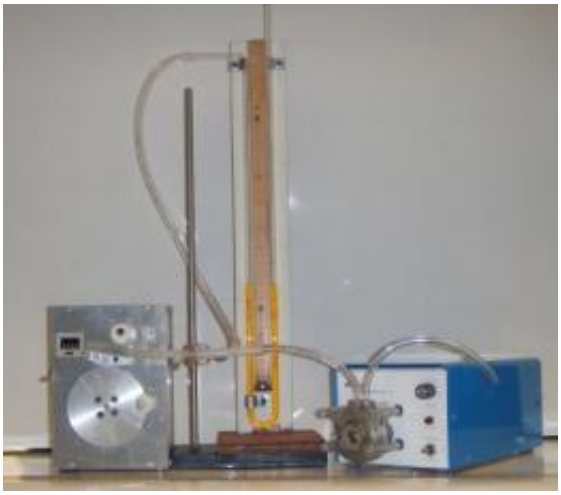

This image shows a smoking machine. From left to right: a puffer box, a manometer, and a pump. Credit: Talbot lab, UC Riverside.

Stronger suction is required to smoke "electronic cigarettes" - marketed as tobacco-free nicotine delivery systems - than conventional brands, with possible adverse effects on human health, researchers at the University of California, Riverside report.

The researchers used a smoking machine to compare the smoking properties of eight conventional cigarettes with five e-cigarette brands. They examined the vacuum required to produce smoke (in the case of conventional cigarettes) or aerosol (in the case of e-cigarettes), and compared the density of the smoke/aerosol over time.

The researchers found that except for one brand (Liberty Stix), higher vacuums were required to smoke e-cigarettes than conventional brands.

The researchers also found that in the case of e-cigarettes, the aerosol density dropped after the first ten puffs, requiring still stronger suction thereafter to produce aerosol.

Study results appeared last week in *Nicotine and Tobacco Research*.

"It is too early to know exactly what effect stronger inhaling and diminishing amounts of aerosol will have on human health, but these factors are likely to lead to compensatory smoking, as has been seen previously with 'light' tobacco cigarettes," said Prue Talbot, a professor of cell biology and the senior author of the research paper.

Talbot's research team examined the following conventional cigarettes: Merit Ultra Lights, Marlboro Ultra Lights, Marlboro Lights, Marlboro Reds, Camel unfiltered, Camel Lights, Camel filtered, and Pall Mall unfiltered cigarettes. In the case of e-cigarettes, the researchers tested the following kits: Liberty Stix, Crown Seven's Hydro Kit, NJOY, Smoking Everywhere's Gold Kit, and a VapCigs starter kit.

"Our work shows that aerosol density decreases as e-cigarettes are used, requiring stronger puffs over time to sustain density," Talbot said. "Manufacturers often claim that e-cigarettes cartridges are equivalent to a certain number of conventional cigarettes. However, this information seems misleading."

Talbot's lab found that while the first ten puffs of an e-cigarette are similar to a conventional cigarette, later puffs were highly variable in aerosol density and do not duplicate smoking of conventional brands. The researchers found that even though one e-cigarette cartridge may smoke for 200 puffs, cartridges do not smoke uniformly for those 200

puffs and therefore do not duplicate nicotine delivery of individual conventional cigarettes.

"Our results show that e-cigarettes smoke very differently than conventional brands," Talbot said. "In preliminary trials, we observed that some brands of e-cigarettes were difficult to smoke possibly because they have relatively small air intake holes. Moreover, the interior of e-cigarettes is dense compared to the relatively porous tobacco-containing cigarettes."

Talbot, who is also the director of the UCR Stem Cell Center, was joined in the research by Anna Trtchounian, the first author of the paper, and Monique Williams of UC Riverside.

The study was supported by the University of California Tobacco-Related Disease Research Program; the University of California Academic Senate; and the Hispanic Serving Institutions-California Cost Reduction and Access Act Science, Technology, Engineering, and Mathematics Pathway Project.

"This paper is the first detailed study showing that greater inhalation pressure is required to smoke e-cigarettes as compared to conventional cigarettes," said Kamlesh Asotra, a research administrator at the University of California Tobacco-Related Disease Research Program. "An important implication is that users must exert greater inhalation pressure and, therefore, it may predictably cause the aerosol to reach deeper tissue in the user's lungs. As in the case of conventional harm reduction cigarettes with lower nicotine content, users of e-cigarettes may also need to smoke greater number of puffs to receive sufficient amount of nicotine to satisfy their craving.

"Based on the results of this paper, not only do users become more aware of the vapor characteristics and smoking properties of e-cigarettes but

also manufacturers of e-cigarettes will take notice of the functional inconsistencies of their products," he said.

About electronic cigarettes:

E-cigarettes are marketed as a relatively new type of tobacco-free nicotine delivery device, consisting of a battery, a charger, a power cord, an atomizer, and a cartridge containing nicotine and propylene glycol.

When a smoker draws air through an e-cigarette, an airflow sensor activates the battery that turns the tip of the cigarette red to simulate smoking and heats the atomizer to vaporize the propylene glycol and nicotine. Upon inhalation, the aerosol vapor delivers a dose of nicotine into the lungs of the smoker, after which, residual aerosol is exhaled into the environment.

While produced mainly in China, e-cigarette use has rapidly proliferated worldwide. E-cigarettes do not burn tobacco and therefore do not deliver the numerous chemicals and toxicants found in conventional cigarette smoke.

To date, little has been published in the scientific literature about the health benefits and risks of e-cigarettes.

About the smoking machine:

The smoking machine consists of a puffer box connected via tubing to a peristaltic pump. The line between the puffer box and the pump contain two untapered T connectors. The connector closest to the puffer box holds the conventional or electronic cigarette. The second connector is attached to an upright U-shaped water manometer built at UC Riverside. The manometer measures the vacuum in the line drawing a puff from

each cigarette.

Provided by University of California - Riverside