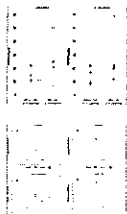


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### Use of electronic cigarettes (e-cigarettes) impairs indoor air quality and increases FeNO levels of e-cigarette consumers

Wolfgang Schober<sup>a</sup>, Katalin Szendrei<sup>a</sup>, Wolfgang Matzen<sup>a</sup>, Helga Osiander-Fuchs<sup>a</sup>, Dieter Heitmann<sup>a</sup>, Thomas Schettgen<sup>a</sup>, Rudolf A. Jörres<sup>a</sup>, Hermann Fromme<sup>a</sup>

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#### Abstract

Despite the recent popularity of e-cigarettes, to date only limited data is available on their safety for both users and secondhand smokers. The present study reports a comprehensive inner and outer exposure assessment of e-cigarette emissions in terms of particulate matter (PM), particle number concentrations (PNC), volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH), carbonyls, and metals. In six vaping sessions nine volunteers consumed e-cigarettes with and without nicotine in a thoroughly ventilated room for two hours. We analyzed the levels of e-cigarette pollutants in indoor air and monitored effects on FeNO release and urinary metabolite profile of the subjects. For comparison, the components of the e-cigarette solutions (liquids) were additionally analyzed.

During the vaping sessions substantial amounts of 1,2-propanediol, glycerine and nicotine were found in the gas-phase, as well as high concentrations of PM<sub>2.5</sub> (mean 197 µg/m<sup>3</sup>). The concentration of putative carcinogenic PAH in indoor air increased by 20% to 147 ng/m<sup>3</sup>, and aluminum showed a 2.4-fold increase. PNC ranged from 48,620 to 88,386 particles/cm<sup>3</sup> (median), with peaks at diameters 24–36 nm. FeNO increased in 7 of 9 individuals. The nicotine content of the liquids varied and was 1.2-fold higher than claimed by the manufacturer.

Our data confirm that e-cigarettes are not emission-free and their pollutants could be of health concern for users and secondhand smokers. In particular, ultrafine particles formed from supersaturated 1,2-propanediol vapor can be deposited in the lung, and aerosolized nicotine seems capable of increasing the release of the inflammatory signaling molecule NO upon inhalation. In view of consumer safety, e-cigarettes and nicotine liquids should be officially regulated and labeled with appropriate warnings of potential health effects, particularly of toxicity risk in children.

#### Abbreviations

DNPH, 2,4-dinitrophenylhydrazine; e-cigarette, electronic cigarette; eCO, exhaled carbon monoxide; FeNO, exhaled nitric monoxide; GC, gas chromatography; HPLC,

high-performance liquid chromatography; 3-OH-cotinine, trans-3'-hydroxycotinine; 3-HPMA, 3-hydroxypropylmercapturic acid; LOD, limit of detection; MS, mass spectrometry; PAH; polycyclic aromatic hydrocarbons; PM, particulate matter; PNC; particle number concentrations; VOC, volatile organic compounds

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Keywords

Electronic cigarette; e-Cigarette; Vaping; Indoor air quality; Nicotine; Volatile organic compounds; Polycyclic aromatic hydrocarbons; FeNO; Health effects; Secondhand smoking

Corresponding author. Tel.: +49 09131 6808 4242; fax: +49 09131 6808 4297.  
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