7-Day E-Cigarette Exposure Effects on Ventilation in Adult Rats

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Introduction

Electronic cigarette usage *(vaping)* is an alternative to smoking, in which vape pens are used to heat and aerosolize liquids often containing nicotine and other chemicals.

Vaping is not harmless!

- *Recent vaping research in humans has shown an increased airway resistance with acute (5 to 60 minutes) e-cigarette exposure. (1, review)*
- *Additionally, there may be a slight decrease in lung function affecting lungs volumes such as tidal volume, inspiratory, and expiratory reserve volume. (1, review)*
- *More research is needed to fully understand both the acute and chronic effects of vaping.*

We can use animal models to mimic vape exposure and assess tissue changes which ultimately will lead to functional changes.

Current research in animal models indicates lung tissue changes with acute and chronic e-cigarette exposure.

- *In rats, after only 15 minutes of exposure there was an increase in the inflammatory cytokines in the lungs (2)*
- *In rats, chronic use of e-cigarettes may lead to alterations in lung tissue morphology which may diminish gas exchange (3)*

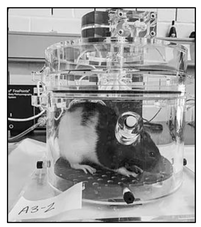
In this study we investigated the effects of 7 days of e-cigarette exposure in adult long-evans rats on lung function and lung tissue cytokine expression.

Methods

Study Timeline

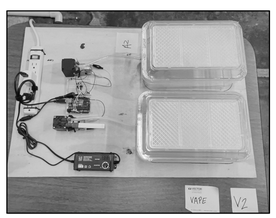
Baseline Ventilation Recordings (Day 0) → Vape (JUUL) or Air Exposure (Days 1-7) → Post-Vape Ventilation Recordings and Tissue Collection (Day 8)

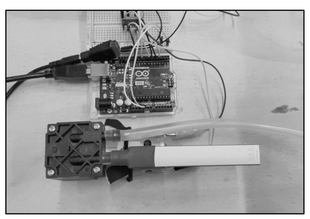
All animal protocols were approved by the SU IACUC (Protocol Stokes 0721)



Whole-Body Plethysmography: *Ventilation was recorded in awake animals (adult Long Evans rats) using Data Sciences International Buxco whole-body plethysmography chambers and FinePoint software. Data was collected on minute ventilation, tidal volume, and breathing frequency both before and after short-term vape exposure (Days 0 and 8, respectively).*

Vape Exposure Chambers: *Rats were individually placed into a vape or air chamber based on study assignment (see Group Numbers table). The vape system, a modified version of (4), was turned on and ran on a continuous program of a 2 second draw of vape or air followed by 4 seconds off. After 4 minutes, the system pumps were turned off, and the rats remained in the chambers for an additional 6 minutes for 10 minutes of total exposure.*





Group Numbers (n)

	Air	Vape
Male	4	6
Female	2	4

Cotinine ELISA: *Blood was collected on Day 8 and processed for serum collection. A rat cotinine ELISA kit was used to measure cotinine (a nicotine metabolite) in the serum. Cotinine presence is an indirect measure of nicotine exposure.*

Tissue Collection: *Lung and heart tissue was also collected on Day 8 and will be processed for presence of inflammatory cytokines at a later date.*

Results and Conclusions

Figure 1: No difference in ventilation patterns was observed in the female air and vape groups (A). The male minute ventilation may show some variation between the air and vape treatments (B); however, this is a very small sample size. Animals were challenged with a hypoxia exposure to assess lung function during oxygen challenge, no differences were observed. *Statistics were not run at this time, due to the small group sizes.*

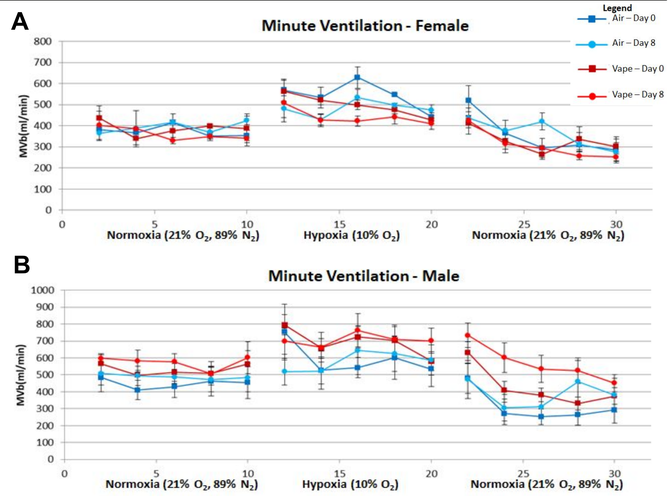


Figure 2: Overall the weights did not change during the course of the study. Weights were recorded on days 1-8 before testing as a health checkpoint.

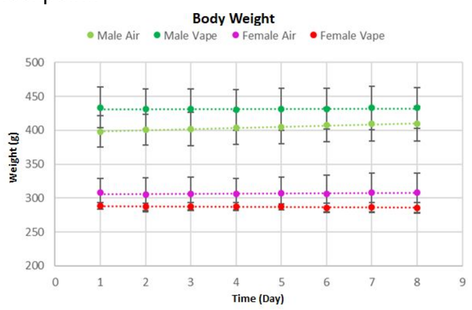


Table 1: Cotinine was present in the serum samples of the vape groups but not the air groups.

Males	Average	St. Dev.
Air	0.00 ng/ml	0.00 ng/ml
Vape	86.55 ng/ml	1.03 ng/ml
Females		
Air	0.00 ng/ml	0.00 ng/ml
Vape	80.43 ng/ml	4.11 ng/ml

- **Due to our study's small sample size, we would like to run this study again to increase the group size (n) to allow for statistical analysis**
- **The collected tissue, lungs and hearts, will be analyzed via ELISA for the presence of proinflammatory cytokines in fall 2021**

References

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