

Effects of nicotine containing JUUL e-cigarette vapor on treadmill-trained rats' aerobic fitness

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Background

- Even as popularity increases, adolescents do not fully understand the risk of nicotine addiction when it comes to vaping (Gorukanti et al., 2017; Russell et al. 2020)
- Vaping can decrease the function of the lungs and increase lung inflammation and infection, as well as alter heart rate and blood pressure (Chaumont et al., 2019; Nguyen et al., 2024)
- Aerobic exercise can alleviate some of the tissue damage caused by vaping (Kuru et al., 2015)
- Exercise can also help people quit vaping by reducing cravings and withdrawal symptoms (Marrero-Cristobal et al., 2022)

Methods

All animal protocols were approved by the SU IACUC (Protocol Stokes_0824)



Stage 1 Rat Handling

Rat handling to acclimate the rats to the researchers, room, and equipment.

Stage 2 Pre-Exposure Training

Adaptation to the treadmill, starting with no speed or shock followed by gradually increasing speed and introducing low shock (aversion stimuli).

Stage 3 Running Test #1 (Baseline)

Baseline running test for aerobic fitness, before treatment (air or vape). See Example testing protocol below.

Stage 4 Training + Exposure

Treadmill training and vape exposure (10 min) based on treatment group (vape n=6, air n=6) over 4 weeks.

Stage 5 Running Test #2 (Post Tx)

Running test for aerobic fitness after treadmill training and treatment (air or vape).

Subjects

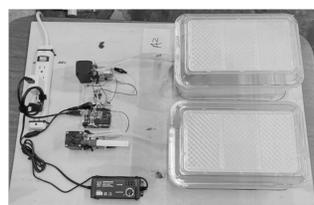
- n = 12
- Male Long Evans rats
- ~8 weeks old at start
- 4 rats were excluded
 - injury, n=1
 - did not complete training protocol, n=3



SEDACOM 2-lane rat Treadmill

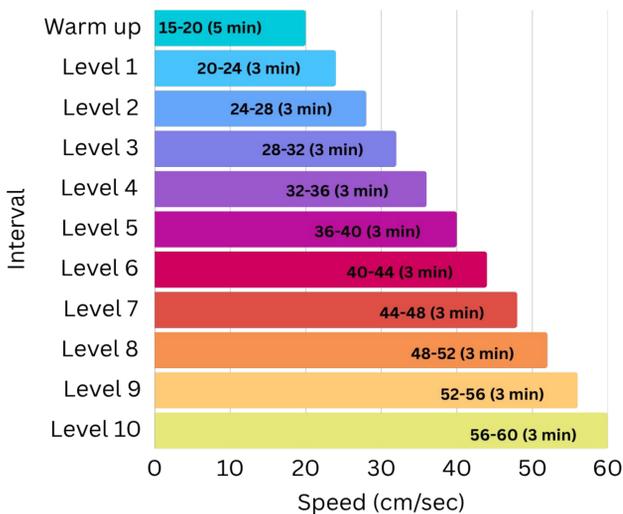


Rat in vape exposure chamber



Vape system (modified from Frie et al., 2020)

Example testing protocol:



Data Analysis

Total time run, peak speed reached, and distance run were compared using a 2 x 3 (Group x Independent Variable) Repeated Measures Model ANOVA.

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*Authors contributed equally to the work.

Purpose/Hypothesis

The purpose of this research is to evaluate the effect of e-cigarette vapor exposure on treadmill training and exercise (aerobic) performance in rats. We hypothesize that if rats are exposed to e-cigarette vapor 5 times a week for 4 weeks throughout a treadmill training protocol, their threshold for peak speed and running distance will decrease compared to rats not exposed to e-cigarette vapor.

Results

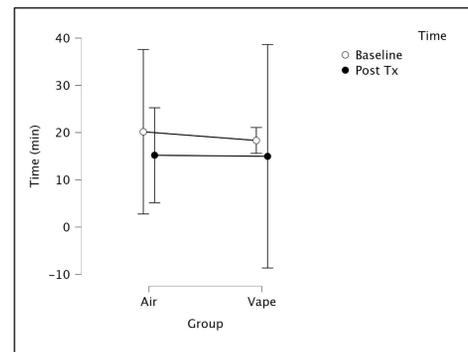


Figure 1: Total Time Running

There was no main effect of time (pretest vs posttest) on time run ($p=.392$). There was no main effect of group on total time run ($p=.844$), and there was no interaction between Group and Time ($p=.696$).

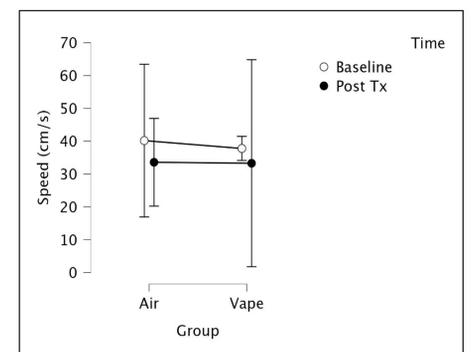


Figure 2: Peak Running Speed

There was no main effect of time on peak speed reached ($p=.393$), neither was there a main effect of group ($p=.847$). There was no interaction between Group and Time ($p=.699$).

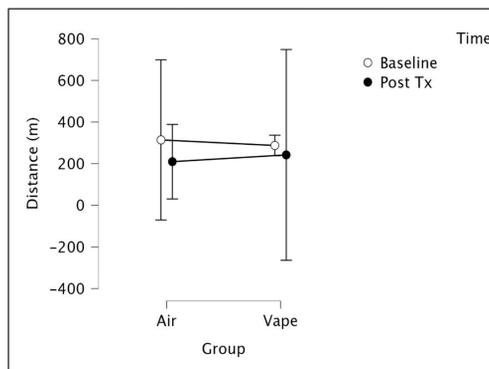


Figure 3: Total Distance Run

There was no main effect of time on distance run ($p=.457$), nor was there a main effect of group ($p=.980$). There was no interaction between Group and Time ($p=.444$).

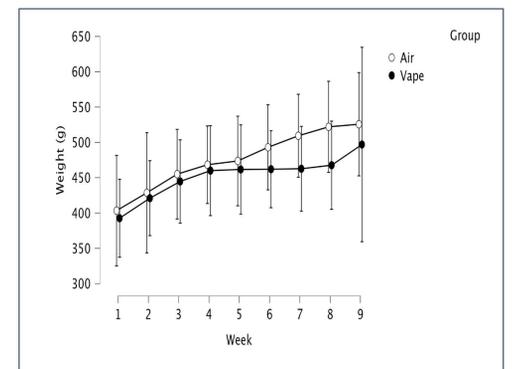


Figure 4: Weights

Simple comparison anova of weight gain between air and vape rats over 9 weeks. There was no significant difference between groups ($p=.518$).

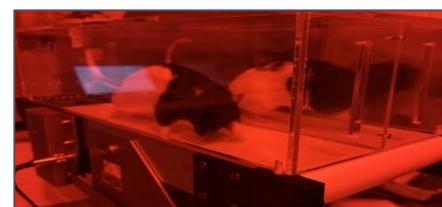


Figure 5: Rats running on treadmill

Rats that were exposed to vapor showed behavioral changes, such as relying more on physical assistance by leaning on the front panel of the treadmill.

Conclusions and Future Plans

- There was no significant difference in exercise parameters between rats exposed to e-cigarette vapor and the control group; however, this is likely influenced by small sample size
- Behavioral changes were observed in the vapor exposed rats, such as obtaining more shocks more quickly and displaying signs of fatigue earlier in the running protocol
- While it's likely that vaping has an impact on aerobic exercise, 10 minutes of vapor exposure per day for a week was not enough to induce statistically significant changes in the ventilatory parameters measured
- Future research should use a bigger sample size, use a vehicle control, and increase the duration or frequency of vapor exposure

References

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