# Evaluating the Variance in Representative Wildfire Pollutant Deposition According to Lung Morphometry

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## Introduction

- Climate change has led to an increase in wildfire events in the United States.[1]
- The size of airborne particles determines where they deposit in the lung.
- This deposition also varies based on factors like age, sex, gender, lung volume, etc.[2]
- Air quality guidance is typically uniform, based on ambient air quality measurements.
- This study explores how deposition of wildfire emissions varies based on demographic differences.

## Methods

### Burn

Combustion of biomass fuel in a custom-designed combustion chamber.

### Measurement

Particle size distributions of emissions were recorded with a particle counter.

### Model

Lung deposition was modeled for a 10-year-old child, adult man, and adult woman using MPPD.[3]

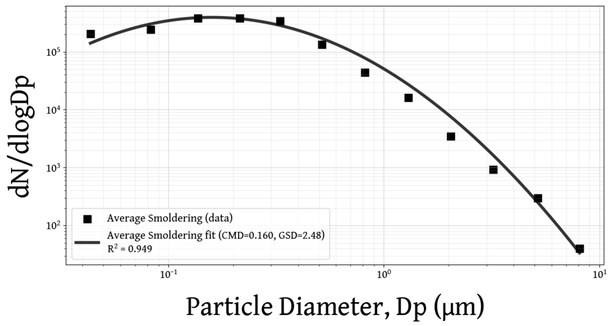



**Figure 1. Average Particle Size Distribution**

## Results

- Results were analyzed based on deposition fraction, assessing whether the same particle size distribution would deposit differently for different demographic models.
- The adult male model exhibited the highest total deposition fraction, while children demonstrated higher TB regional deposition and the adult female model recorded higher pulmonary regional deposition (Fig. 2).
- Deposition fractions were normalized for lung surface area, revealing elevated deposition peaks over 30% higher for the child model compared to the male (Fig. 3).

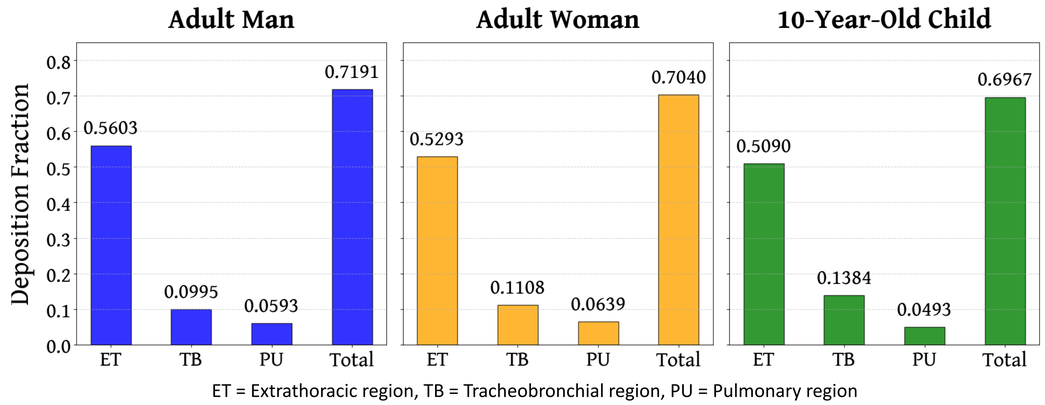



**Figure 2. Regional deposition fraction by model**

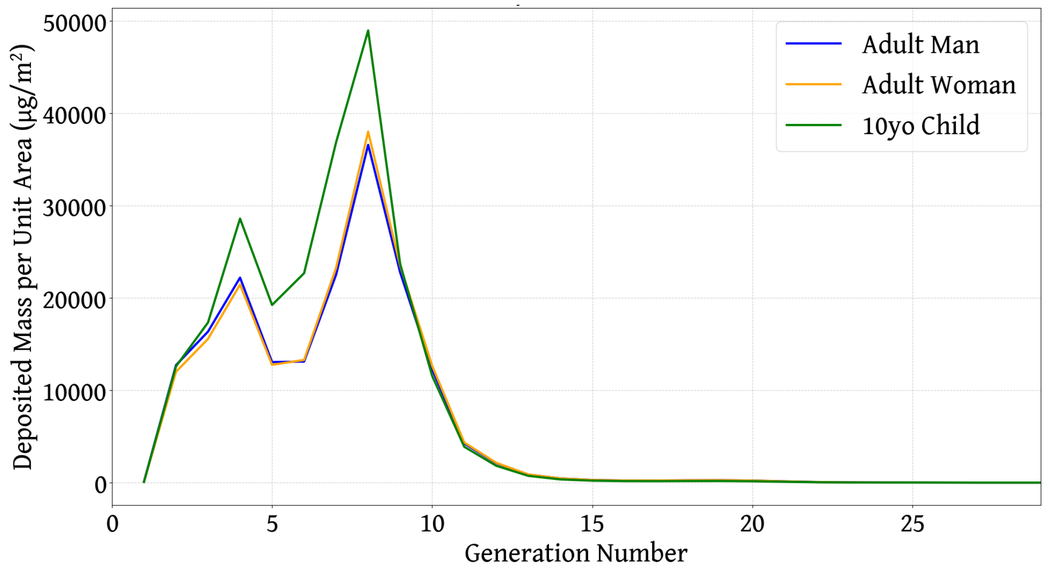



**Figure 3. Mass Deposited/Lung Unit Area vs. Generation Number by model.**

Generation number refers to the branching level, where 0 is the trachea and around 23 and deeper represents the alveolar sacs.

## Conclusion

- Surface area normalization revealed higher pollutant deposition peaks for the female and child models, especially elevated at higher generation numbers.
- These findings indicate ambient air exposure data may not be sufficient to convey varying risks for different people exposed to wildfires.
- However, this data is limited to modeling a single child, man, and woman under simulated combustion experiments. More research could test deposition with additional variables like other age groups, distance and time of exposure, and posture or exposure activity.

## Occupational Health Relevance

- PPE and emergency advisories for firefighters and first responders should reflect demographic differences to appropriately convey risks.

## Acknowledgements

Python code for data visualization was generated with the assistance of Google Gemini 3.1 Pro and Claude Sonnet 5.5.

## References

1. J.T. Abatzoglou, & A.P. Williams, Impact of anthropogenic climate change on wildfire across western US forests, *Proc. Natl. Acad. Sci. U.S.A.* 113 (42) 11770-11775.
2. Brown JS, Gordon T, Price O, Asgharian B. Thoracic and respirable particle definitions for human health risk assessment. *Part Fibre Toxicol.* 2013;10:12.
3. U.S. Environmental Protection Agency, Multiple-Path Particle Dosimetry Model (MPPD), version 2.0 (U.S. EPA, 2025).

# OHS Motivation and Error Performance in Aviation: A Cognitive Approach

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## Background

- Human factors and errors account for approximately 75% of aviation accidents.[1]
- Understanding the motivational factors that drive safe work behavior, known as occupational health and safety (OHS) motivation, is essential to improving safety outcomes.
- Workers engaged in internal (i.e., identified and intrinsic) OHS motivation demonstrate improved performance when compared to those functioning under external OHS motivation.[2]
- The mechanism through with OHS motivation impacts workplace performance is unclear.
- Time is a critical component in aviation. The Military Services cite a relentless operations tempo (OPSTEMO)[3] and civil aviation focuses on aircraft uptime.
- Cognitive control describes an individual's ability to regulate their responses rather than act quickly based on instinct or impulse.[4]

## Objectives

1. Quantify the frequency and type of errors committed by aviation workers over a six-month period and analyze their association with self-reported OHS motivation.
2. Examine the pathway between internal OHS motivation, cognitive control, and error incidence.

## Study Population

Aviation workers: maintainers, wing walkers, cargo loaders, ground personnel

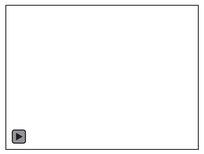


**Figure 1: The Stroop Test**

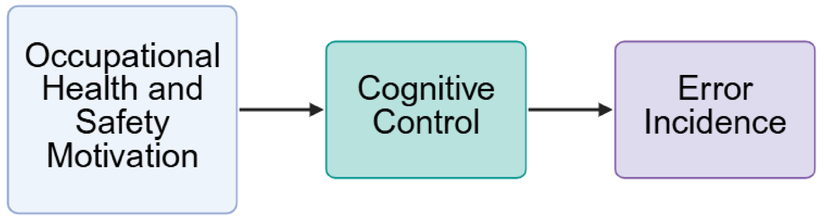



**Figure 2: Proposed pathway linking occupational health and safety (OHS) motivation, cognitive control, and error incidence**

## Experimental Design

- Prospective cohort study design

**Participants Complete:**

- 4 tasks while vagally-mediated heart rate variability (vmHRV) is measured

| Item |
|---|
| *Why do you put effort into working safely?* |
| Because I have fun while working safely |
| Because it makes me happy |
| Because I enjoy working safely |

**Figure 3: SDSM Scale Intrinsic Motivation Line Items**




**Figure 4: The Stroop test**

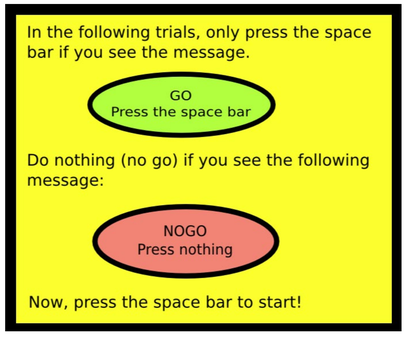



**Figure 5: Go/No-go task**

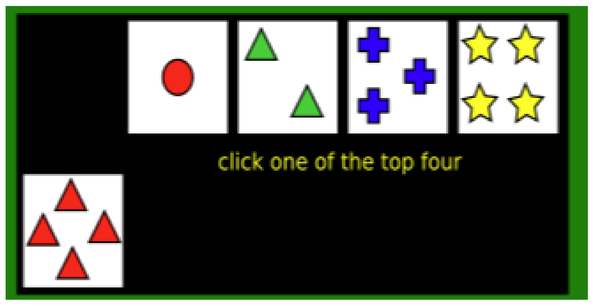



**Figure 6: Wisconsin Card Sorting Test (WCST)**

- vmHRV and results of Stroop test, Go/No-go task, and WCST used as a composite measure of cognitive control
- For the following six months, participants will self-report workplace errors, injuries, and illnesses on a weekly basis

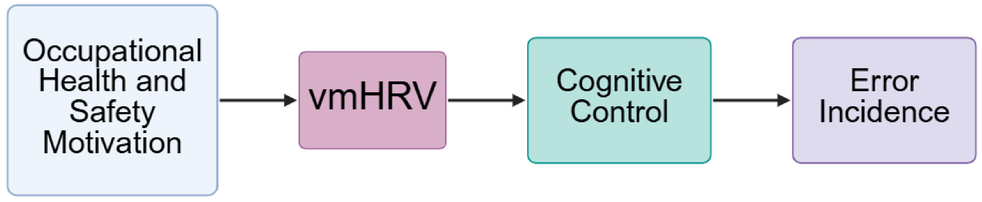



**Figure 7: Secondary pathway to be investigated with vagally-mediated heart rate variability as an additional, serial mediator**

## Limitations

- Participant recruitment focused on a specific population, which may limit generalizability.
- Cognitive control varies across individuals, and environments making standardization challenging.

## Expected Results

- Quantify the phenomenon of internally motivated individuals committing fewer errors.
- Elucidate the pathway through which motivation and errors are connected.
- Determine if workers with higher internal motivation commit fewer workplace errors, particularly those resulting in injury and illness.
- Determine the role of cognitive control in aviation worker performance

## Future Directions

- Evaluate the role of cognitive control in the context of each worker category environmental context.
- Examine the mechanisms through which OHS motivation translates into sustained safe behaviors in the workplace.

## Acknowledgements

This research study was supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42OH008432.

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2. Mark, F. *Assessing Employee Safety Motivation Using Self-Determination Theory*. 2014 2014– 03–17; Available from: https://policycommons.net/artifacts/1200411/assessing-employee safety-motivation/
3. National Committee on Military Aviation Safety. *Report to the President and the Congress of the United States*. 2020
4. Badre, D., *Cognitive Control*. Annual Review of Psychology, 2025. **76** (Volume 76, 2025): p. 167–195.

# ASSESSMENT OF INDOOR MOLD BURDEN IN A RESIDENTIAL SETTING USING A MULTI-LAYERED STRATEGY: A CASE STUDY

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## INTRODUCTION

- About **47%** of U.S. homes have dampness or moisture conditions that can promote mold growth [1]
- Mold is ubiquitous and present in both indoor and outdoor environments [2]
- Indoor moisture and mold are associated with respiratory and allergic adverse effects, including allergic rhinitis, asthma exacerbation, hypersensitivity pneumonitis, allergic bronchopulmonary aspergillosis, etc [3]
- ***There are currently no U.S. federal regulations or exposure limits for airborne mold [4]***



Sourcehttps://www.rdsenvironmental.com/wp-content/uploads/2017/11/ThinkstockPhotos-637186808.jpg

## OBJECTIVES

- Quantify mold concentrations in affected rooms
- Evaluate the effectiveness of a multilayered 24-hour control strategy

**Contact: Judith Arthur (arthurjt@mail.uc.edu)**
**Sripriya Nannu Shankar (nannussa@ucmail.uc.edu)**

## THE FAMILY'S JOURNEY

- Move-in
- Independent home assessment
- Respiratory symptoms develop
- Elevated mold detected
- Hospital visits
- Family temporarily relocates
- Indoor environment???
- Repairs and remediation

## OUR INVESTIGATION

**Sampling location**: Bathroom and Bedroom

**Sampling Instruments**

- GRIMM spectrometer: Aerosol concentration
- Instascope: Total fungal concentrations
- Spore trap: Mold spore diversity and composition

**Study Timeline and Intervention**

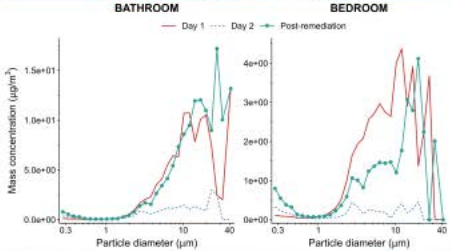
**Day 1**: Baseline assessment

- 24-hour Intervention: (EPA-recommended mold control agent, air purifier, UV-C lamps, natural ventilation

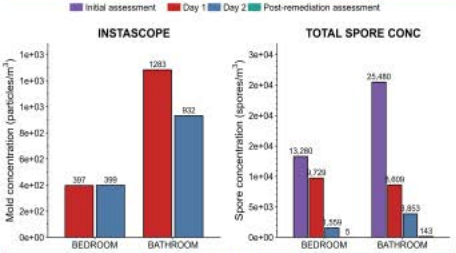
**Day 2**: Post-intervention Assessment

**2-Month Follow-up**: Post-remediation Assessment

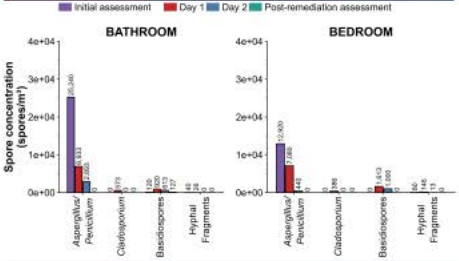
## MASS DISTRIBUTIONS




## MOLD CONCENTRATIONS




## FUNGAL TAXA




## CONCLUSION

- Aspergillus/Penicillium was the dominant taxon
- ↓Total spore concentrations and fungal composition changed over time
- ↓ in bathroom concentrations after intervention.

## REFERNCES

1. Coulburn, L., & Miller, W. (2022). Prevalence, risk factors and impacts related to mold-affected housing: An Australian integrative review. International Journal of Environmental Research and Public Health, 19(3), Article 1854. https://doi.org/10.3390/ijerph19031854
2. Shakil Ahmed Saghir, J. B., Rais Ahmed Ansari, (2025). Molds and mycotoxins indoors III: Three case reports. Archives of Clinical Toxicology, 7(1), 41–45.

# Wearable Cool Pants for High-Temperature Work Environments

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[NIOSH Pilot Research Project Training Program]

## Occupational Heat Stress: Need, Rationale, and Project Objective

*NIOSH PRP pilot project • lower-body wearable cooling for high-temperature work*

### Why this matters

- High-heat occupations face elevated thermal strain, fatigue, discomfort, and potential loss of work capacity.
- Protective clothing can increase retained body heat and limit natural heat dissipation.
- Lower-body cooling is physiologically relevant because cooling large leg surfaces can reduce cardiovascular strain and perceived exertion.

### Overall project goal

**Develop and validate lightweight "Cool Pants" that provide targeted lower-body cooling while preserving mobility, comfort, and occupational practicality.**

### Technical objective

Integrate localized cooling, lateral heat spreading, and wearable temperature / humidity monitoring into commercially available cargo pants.

### Validation objective

Quantify cooling distribution, thermal response, comfort, mobility, and feasibility using laboratory, thermal-manikin, and human-relevant testing.

**Design principle: cool locally → spread heat laterally → measure objectively → refine for real work tasks**

1

## Prototype Architecture: Dual Cooling Modes + Graphite Heat-Spreading Layer

*Two interchangeable cooling strategies enable performance / cost trade-offs*







### Mode A — Short, intensive

Fan + battery + cold packs in a low-profile pocket housing.

### Mode B — Sustained

Portable thermoelectric module with adjustable cooling level.

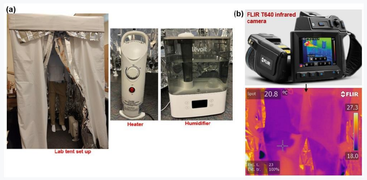
### Graphite composite function

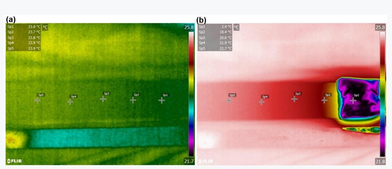
A thin graphite sheet laminated with textile layers is positioned near the thigh to spread localized cooling laterally while retaining garment flexibility.

2

## Preliminary Proof-of-Concept: Local Cooling and Lateral Heat Spreading

*Infrared thermography demonstrates rapid cooling and spatial propagation along the thigh panel*




| 6.5 °C | 7.4 °C | >20 cm | ≈4.5 h | ≈8 h |
|---|---|---|---|---|
| local decrease after 5 min 27.3 → 20.8 °C | ice-pack decrease after 5 min 25.8 → 18.4 °C | observed cooling spread across thigh region | thermoelectric runtime at strong cooling | runtime at low cooling |

**Preliminary interpretation**

The graphite-based panel extends the thermal effect beyond a single contact point, supporting the design hypothesis that lateral heat spreading can increase cooled surface area without adding multiple bulky cooling devices.

3

## Research Design and Experimental Validation Framework

*Sequential prototype-to-validation workflow designed to reduce technical and human-testing uncertainty*

**Fabrication** → **Fabric integration** → **Lab screening** → **Manikin testing** → **User testing**

### Controlled laboratory screening

- FLIR surface-temperature maps
- Embedded temperature / RH sensing
- High-temperature / humidity exposure
- Compare cooling modes and panel placement

### Sweating thermal manikin

- NIOSH climate chamber
- Heat flux and thermal burden
- Evaporative resistance / moisture transport
- Repeatable baseline before human testing

### Human-relevant assessment

- Industrial workers + UC participants
- Walking, kneeling, lifting, rising, squatting
- Comfort, mobility, local thermal response
- Iterative prototype refinement

**Decision logic: objective thermal metrics identify the most promising configuration → human testing evaluates whether the same design remains practical during occupational movement.**

4

## Study Population, Measurements, and Outcome Variables

*Pilot-scale human-relevant testing complements the objective manikin evaluation*



### Study population

5 industrial workers with regular heat exposure; three visits each. Additional UC participants broaden fit, comfort, mobility, and response data.

### Standardized tasks

Lifting, kneeling, rising, walking, seated / body-weight squats, and other representative lower-body occupational movements.

Pilot design is intentionally small and aimed at generating data for future expanded studies.

### Thermal measurements

FLIR T640 surface mapping; local temperature and humidity sensors; wearable skin-temperature measurement.

### Physiological / activity

Zephyr BioHarness 3.0 for heart rate, activity, and physiological-response tracking during movement.

### Primary outcomes

Local temperature reduction; heat-stress indicators; cooling uniformity; comfort; perceived exertion; mobility; wearability.

### Comparative analysis

Compare fan/cold-pack versus thermoelectric strategies and relate controlled manikin metrics to human-centered performance.

**Human-subject emphasis: feasibility and usability rather than definitive clinical efficacy.**

5

## PRP Budget, Prototype Cost, and Translation Path

*$7,000 direct-cost pilot structured around prototype fabrication, measurement, and validation*

### PRP direct-cost allocation

| | |
|---|---|
| Personnel | $2,300 |
| Materials & supplies | $4,000 |
| Instrument use | $600 |
| Dissemination | $100 |

### Scalability lever 1

Commercial off-the-shelf components reduce development and supply-chain risk.

### Scalability lever 2

Thermoelectric hardware is the major cost driver; standardization and bulk sourcing offer the largest reduction opportunity.

### Scalability lever 3

Replace 3D-printed housings with molded parts and simplify sensor integration for lower unit cost.

### Field flexibility

Dual-mode architecture supports either higher-performance thermoelectric cooling or a lower-cost fan/cold-pack option.

| $7,000 | ≈$605 |
|---|---|
| PRP award | current prototype component cost |

**Translation objective: validated pilot prototype → PPE manufacturing refinement → larger industry-supported study**

6

## Expected Outcomes, Limitations, and Risk-Mitigation Strategy

*Pilot success is defined by reproducible thermal benefit plus practical wearability*

### Expected outcomes

- Measurable localized reduction in thermal burden
- Lower perceived heat stress during movement
- Quantitative linkage among FLIR, manikin, and user-centered data
- A lightweight prototype suitable for iterative refinement

### Known limitations

- Small occupational cohort within pilot budget
- Core temperature may change only modestly in moderate short-duration testing
- Performance depends on ambient heat, humidity, fit, and movement
- Cooling intensity competes with battery duration and device mass

### Mitigation / contingency

- Two alternative cooling modes
- Controlled manikin baseline before human testing
- Additional UC participants for usability data
- Iterative optimization guided by thermal imaging and sensor measurements

**Pilot success criterion: demonstrate a reproducible and practical lower-body cooling effect, quantify thermal performance, and select the most promising architecture for expanded future testing.**

7

## Project Impact and Future Directions

*A modular lower-body cooling platform intended for translation to occupational heat-exposure settings*

### Wearable integration

Cooling is embedded in commercially available cargo pants rather than a separate vest or bulky external system.

### Dual-mode cooling

Fan/cold-pack and thermoelectric options support different cost, duration, and intensity requirements.

### Heat spreading

Graphite-based composite extends the cooling footprint across the thigh region.

### Objective validation

Thermography, sensors, and sweating-manikin testing provide quantitative performance metrics.

### Human relevance

Worker and UC participant testing addresses comfort, mobility, fit, and task compatibility.

### Translation pathway

Results can support larger cohorts, adaptive control, lower-cost manufacturing, and PPE-industry partnerships.

**Long-term goal: a lightweight, manufacturable cooling garment that helps reduce heat strain without interfering with normal occupational movement.**

8

## Acknowledgements, Project Team, and Selected References

*Pilot Research Project Training Program • University of Cincinnati Education and Research Center*

### References

- Alkemade P. et al. Med. Sci. Sports Exerc. 2023;55:2014. Lower- vs upper-body cooling during exercise in heat.
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- OSHA. Heat Stress Guide / Heat Hazard Recognition.

### Acknowledgement

This research study was supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42OH008432.

### Project team / support

Maliha Marzana — Principal Investigator
Qichen Fang — Postdoctoral Fellow
Vesselin Shanov — Mentor
UC ERC / PRP Program
UC Biomechanics Ergonomics Research Laboratory

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9

# Occupational Exposure to Understudied Toxicants in Aviation Gasoline (Avgas) Combustion Emissions Air

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## BACKGROUND

Aviation gasoline (avgas) is the only U.S. transportation fuel that contains lead, and piston-engine aircraft release approximately 438 tons annually (FAA, 2019; Lacerda et al., 2023).




Studies have linked avgas use to elevated lead exposure in nearby communities and aviation workers (Miranda et al., 2011; Park et al., 2013; Zahran et al., 2023; Berg et al., 2024).

However, as aviation transitions from leaded 100LL toward unleaded alternatives such as UL94, the broader mixture of combustion-generated particles and toxic organic compounds, and how these emissions differ between fuels, remains poorly characterized.

## HYPOTHESIS

100LL and UL94 will produce distinct toxicant profiles and particle characteristics under piston-engine-relevant conditions.

## AIMS/OBJECTIVES

1. Characterize toxic organic compounds in leaded (100LL) and unleaded (UL94) avgas emissions, focusing on thio-PAHs, nitro-PAHs, oxy-PAHs, and α-dicarbonyls.
2. Characterize and compare particulate emissions from 100LL and UL94, including particle size distribution, number concentration, and morphology, under piston-engine-relevant conditions.

## POTENTIAL STUDY IMPACT

- Identify priority pollutants for occupational monitoring.
- Inform workplace hygiene and protective strategies.
- Support safer fuel formulation and the transition to unleaded fuel.

## METHOD / STUDY DESIGN

### FUEL TYPE

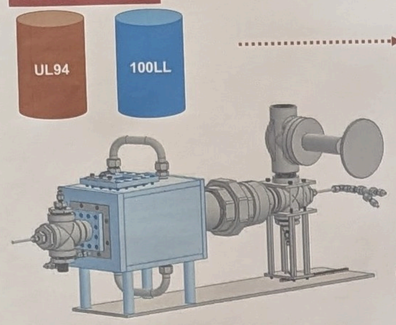



Figure 2: Overall view of the fuel combustor

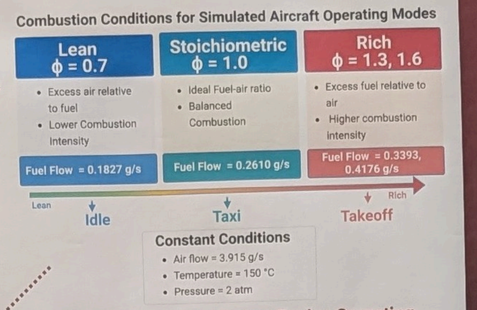



Figure 1: Simulated Piston-Engine Operating Conditions for Avgas Combustion

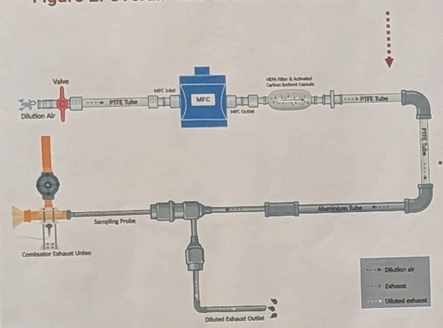



Figure 3: Emission Sampling Train

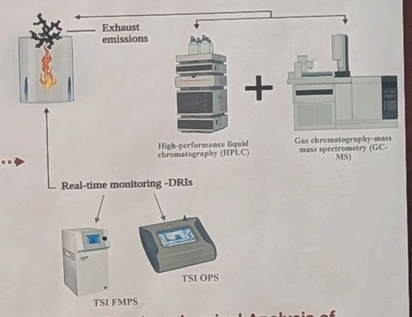
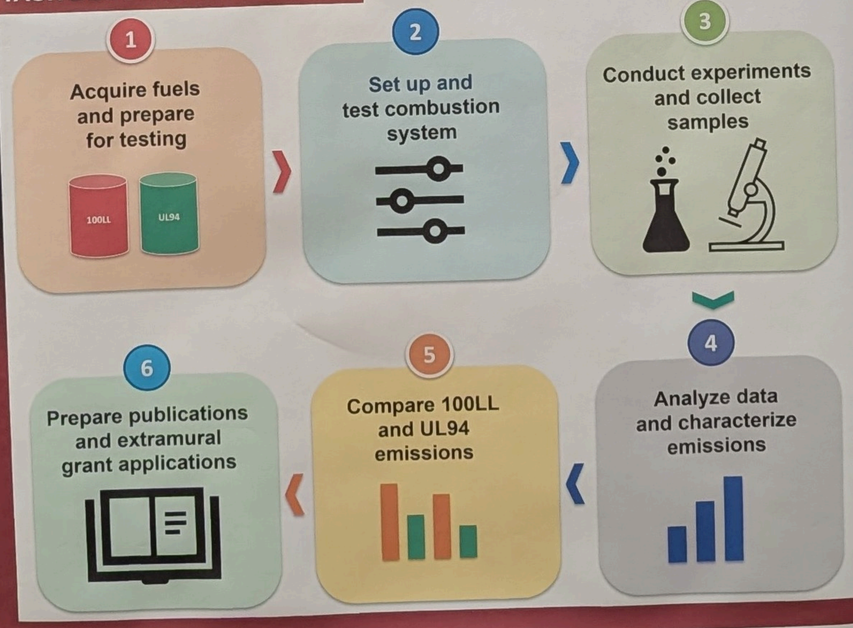
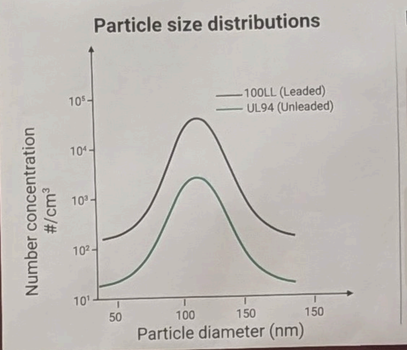


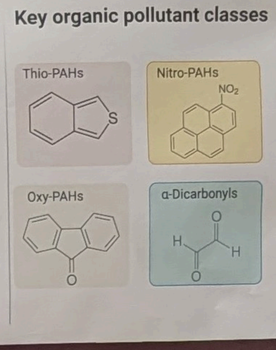

Figure 4: Physico-chemical Analysis of Samples

## TASK DESCRIPTION




## EXPECTED RESULTS




## STUDY LIMITATIONS

- Laboratory combustion may not fully represent real-world piston-engine emissions.
- Emission measurements do not directly indicate worker exposure or health effects.
- Studied fuels and operating conditions require field validation before broader generalization.

## FUTURE DIRECTION

- Complete emission characterization
- Leverage pilot data for extramural grants
- Publish and disseminate findings

## ACKNOWLEDGEMENT

This research study was supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42OH008432.

## REFERENCES

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2. FAA, F. A. A. (2019, 11/20/2019). *Leaded Aviation Fuel and the Environment*. Retrieved 9/1/2025 from https://www.faa.gov/newsroom/leaded-aviation-fuel-and-environment

# Air Pollutant Emissions from Major Ohio Airports: A Comparative Analysis of the 2023 EPA National Emissions Inventory

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## BACKGROUND

Airports are important sources of criteria air pollutants and hazardous air pollutants (HAPs) from aircraft operations and ground support activities. These emissions raise occupational and environmental health concerns, particularly for workers operating near emission sources. However, comparative data on the magnitude, composition and sources of emissions across Ohio's major commercial airports remain limited.



## AIMS / OBJECTIVES

- Quantify and compare estimated criteria pollutant, hazardous air pollutant (HAP) and lead emissions across four Ohio airports.
- Identify major emission sources and their relative contributions using EPA Source Classification Codes (SCCs).
- Identify pollutants and emission patterns relevant to future occupational and environmental exposure assessments.

## METHODS

- Study area: Four Ohio airports - Cleveland Hopkins (CLE), John Glenn Columbus (CMH), Dayton (DAY) and Akron-Canton (CAK).
- Data source: 2023 U.S. EPA National Emissions Inventory (NEI), using facility-level and point-source process datasets.
- Emissions analysis: Six criteria pollutants, the ten highest-emitted hazardous air pollutants (HAPs) and lead were compared across airports.
- Source contributions: EPA Source Classification Codes (SCCs) were used to classify emission sources and calculate their percentage contributions by airport and pollutant.
- Data analysis: JMP was used for data cleaning and preparation, while R was used for emissions aggregation and visualization.

**Scan Barcode to Access the Raw Dataset**

## RESULTS

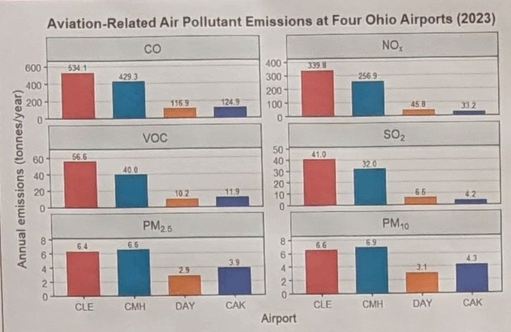



Figure 1: Annual emissions of selected air pollutants at four Ohio airports

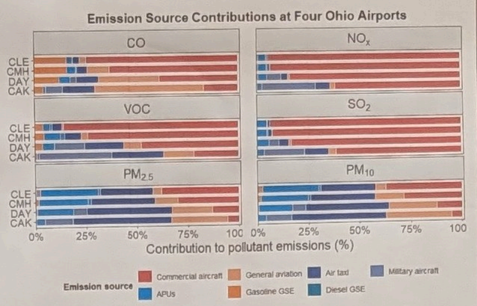



Figure 2. Source Contributions to Criteria Pollutant Emissions at Four Ohio Airports

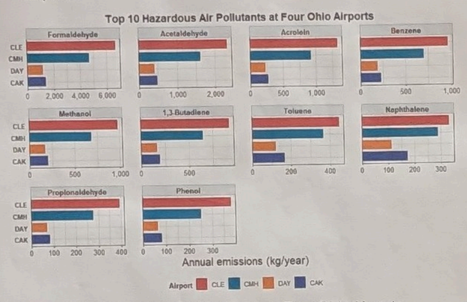



Figure 3: 10 Hazardous Air Pollutants at Four Ohio Airports

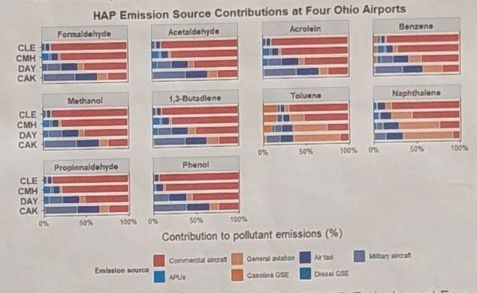



Figure 4. Source Contributions to the Top 10 HAP Emissions at Four Ohio Airports

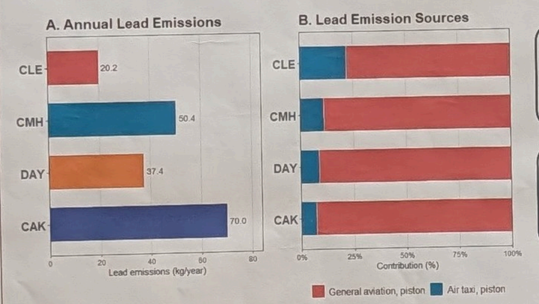



Figure 5: Lead Emissions and Major Sources at Four Ohio Airports

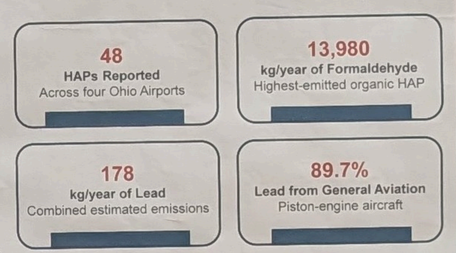



Figure 6: Key Findings at a Glance

*APU = Auxiliary Power Unit; GSE = Ground Support Equipment; CO = Carbon Monoxide; $NO_x$ = Nitrogen Oxides; $SO_2$ = Sulfur Dioxide; VOC = Volatile Organic Compounds; PM = Particulate Matter; Pb = Lead; CLE = Cleveland Hopkins International Airport; CMH = John Glenn Columbus International Airport; DAY = Dayton International Airport; CAK = Akron-Canton Airport.*

## DISCUSSION

- Emissions varied by airport, pollutant and source.
- CLE had the highest emissions of the ten leading HAPs; formaldehyde had the greatest combined mass.
- Formaldehyde, benzene and 1,3-butadiene are classified as carcinogenic to humans by IARC.
- CAK had the highest lead emissions; approximately 90% of total lead emissions came from general aviation piston-engine aircraft.
- Source contributions differed substantially across pollutants, demonstrating the importance of examining individual emission sources rather than airport-wide totals alone.
- These findings identify priorities for occupational exposure monitoring, although actual worker exposures were not measured.

## CONCLUSION

- The study establishes an emissions-based baseline for identifying pollutants and their major sources at four Ohio airports.
- The findings provide a basis for prioritizing pollutants, airport activities and worker groups for targeted occupational exposure assessments.
- Combining emissions inventories with personal and task-based exposure monitoring can inform targeted exposure prevention and strengthen occupational health protection for aviation workers.

## STUDY IMPACT & FUTURE OUTLOOK

- Provides a comparative baseline of aviation-related emissions at four major Ohio airports.
- Identifies priority pollutants, emission sources and airports for targeted air-quality monitoring.
- Supports future personal and task-based exposure assessments to inform occupational exposure prevention.

## STUDY LIMITATION

- NEI estimates emissions, not ambient concentrations or actual worker exposures; occupational health risks cannot be determined from these data alone.
- Annual NEI estimates do not capture short-term emission peaks or variations associated with specific airport activities and worker tasks.
- The inventory does not account for meteorological conditions, pollutant dispersion or proximity to emission sources, which influence actual worker exposure.

## ACKNOWLEDGMENT

- We sincerely thank Prof. Yevgen Nazarenko for providing the platform and opportunity for this research collaboration, and the U.S. Environmental Protection Agency (EPA) for making the 2023 National Emissions Inventory publicly available.

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# Assessing Postural Stressors and Musculoskeletal Discomfort Among Automobile Mechanics and Technicians

*Dickson Rungere[1], Mercy Omoifo-irefo[1], Kermit G. Davis[1]*

*[1] Low Back Biomechanics and Workplace Stress Laboratory, University of Cincinnati, Cincinnati, OH*

## Introduction

- **Automotive service industry employed about 805,000 mechanics and technicians, projected to grow 4% from 2024-2034[1]**
- **Repair work exposures[2]:**
  - Repetitive movements
  - Awkward and static postures
  - Forceful exertions
  - Vibration
  - Heavy lifting
- **Limited research into continuously quantified postural stressors during automobile repair work**

## Methods

- **Cross-sectional observational study during a single work shift**
- **30 full-time automobile mechanics and technicians in Cincinnati, Ohio:**
- **Complete informed consent process**
- **Complete demographics survey and anthropometry**
- **Complete pre-shift discomfort survey**
- **Xsens system will record whole-body posture: 17 Sensors**
- **Complete post-shift discomfort survey**

## Expected Outcome

- **Quantitative data on postural load**
- **Identification of high-risk postures in different body regions and corresponding work tasks**
- **Relationship between self-reported discomfort and quantified postural load in different body regions**
- **Provide baseline information on ergonomic postural stress among automobile mechanics and technicians**

## Data Analysis

- **Descriptive statistics: means, standard deviations, ranges, and frequency/percentages of specified postural angles**
- **Histograms will characterize posture patterns**
- **Linear and logistic regression will evaluate the relationship between posture and discomfort**



**(a) Participant Wearing Sensors** **(b) Mechanic Working**

## Objectives

- **Quantify the postures of automobile mechanics and technicians using wearable sensors**
- **Examine the relationship between quantified postures and self-reported body discomfort.**

## Potential Challenges

- **Technical Issues: sensor fall, signal loss**
- **Recruitment challenges**
- **Participants' activities sometimes interfere with the placement of sensors**

## Acknowledgements

NIOSH-ERC PRP Grant #T42OH008432

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2. Patel, B., Patel, M., & Parmar, A. (2023). International Journal of Health Sciences and Research, 13(7), 237–243.

# Changes in Self-Reported Vocal Symptoms Among University Professors Before and After a Teaching Semester

Jackson State University
Dr. Dawn Stanley, CCC-SLP

## Introduction

**Occupational voice use is a significant concern for individuals who rely on their voices for their work.** Teachers represent the largest occupational voice-user group studied and have a high prevalence of voice disorders. University professors, however, remain comparatively understudied despite substantial vocal demands associated with prolonged teaching in an academic setting with minimal time for vocal rest.

Kyriaki et al. (2018) surveyed 196 university professors using the Voice Disorder Index and found that **35% reported experiencing slight to profound voice disorders**. Vocal symptoms may result from vocal misuse or overuse, defined as excessive or inappropriate use of the vocal mechanism. Persistent vocal symptoms may contribute to voice disorders and negatively affect teaching effectiveness.
Voice problems also have occupational and economic implications. Approximately **one-third of individuals with voice disorders may experience work-related absence**, contributing to substantial economic costs in the United States (Verdolini & Ramig, 2001).

**Purpose:** This project examined changes in self-reported vocal symptoms before and after a teaching semester following a vocal health intervention.

**NORA Relevance:** This study supports **NORA's Healthy Work Design and Well-Being** priorities by examining occupational vocal health among university professors. Identifying changes in self-reported vocal symptoms may help identify occupational risk factors and inform prevention strategies that promote sustainable vocal health for professional voice users.

**Research Question:** What changes occur in self-reported vocal symptoms before and after an academic teaching semester among university professors following a vocal health intervention?

## Methods

**Design:** Pre-test/post-test survey of professors before and after a teaching semester.

**Participants:** 43 university professors (34 female, 9 male) from Jackson State University and Western Kentucky University.

**Intervention:** Participants viewed the recorded educational intervention, *Caring for Your Voice: Maintaining Vocal Health for Teaching*. This intervention was designed specifically for teachers and included strategies for vocal hygiene, reducing vocal strain, and supporting vocal health.

**Measures:**

- Pre-survey: 18-item questionnaire:
  - Vocal Symptoms (9), Demographics (4), Awareness (2), Severity Level (1), Explain how symptom(s) affected teaching (1), Email (1)
- Post-survey: 10-item questionnaire:
  - Vocal Symptoms (9) and Email address (1)

**Procedures:**

- Participants completed the pre-survey.
- Viewed the 1-hour educational intervention.
- Completed the post-survey two weeks after the semester.

**Data Analysis:** Paired-samples t-tests were used to examine pre-to-post test changes ($p < .05$).

## Results

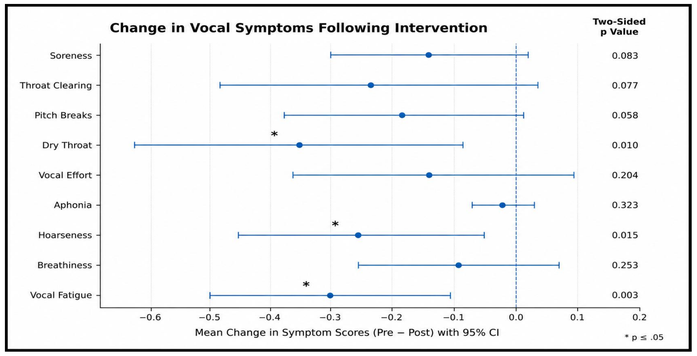
**Pre–Post Survey Differences**

*Paired Samples Test*

| Self-Perceived Symptoms | Mean Scores (Pre / Post) | Mean Change (Pre – Post) | 95% CI | | Significance Two-Sided $p = < .05$ |
|---|---|---|---|---|---|
| | | | Lower | Upper | |
| Vocal Fatigue* | 1.51 / 1.81 | -.302 | -.499 | -.106 | .003 |
| Breathiness | 1.12 / 1.21 | -.093 | -.255 | .069 | .253 |
| Hoarseness* | 1.47 / 1.72 | -.256 | -.458 | -.053 | .015 |
| Aphonia | 1.00 / 1.02 | -.023 | -.070 | .024 | .323 |
| Vocal Effort | 1.37 / 1.51 | -.140 | -.358 | .079 | .204 |
| Dry Throat* | 1.56 / 1.91 | -.349 | -.608 | -.090 | .010 |
| Pitch Breaks | 1.14 / 1.33 | -.186 | -.379 | .007 | .058 |
| Throat Clearing | 1.72 / 1.95 | -.233 | -.491 | .026 | .077 |
| Soreness | 1.33 / 1.47 | -.140 | -.298 | .019 | .083 |

* Significant difference $p = < .05$

- **Self-reported symptoms increased after a teaching semester, indicating worsening symptoms.**
- **Statistically significant worsening of symptoms was observed in (1) Vocal Fatigue, (2) Hoarseness, and (3) Dry Throat**
- **Matched response rate: 70%**




Negative values indicate an increase in vocal symptom scores post-teaching semester. $p \leq .05$ indicates statistical significance.

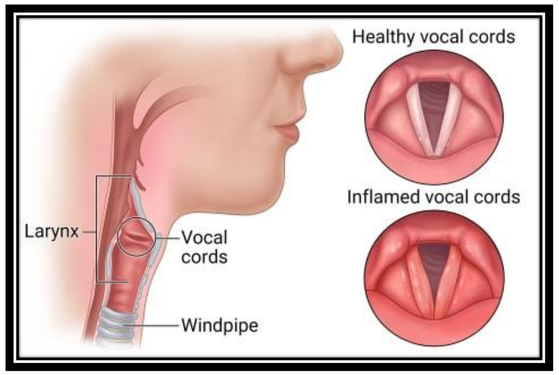



**Figure 1. Laryngitis. Columbia University Irving Medical Center (2026)**

**Healthy vocal folds are smooth and symmetrical, allowing effective vibration. Vocal misuse or overuse can cause inflammation and swelling, which may contribute to vocal fatigue, discomfort, and changes in voice quality.**

## Conclusion

This study highlighted that self-reported vocal symptoms increased across a teaching semester. Specifically, results for vocal fatigue, hoarseness, and dry throat were statistically significant using a two-tailed test. These findings suggest that university professors use their voices in vocally demanding ways throughout the day during lectures. Vocal fatigue, hoarseness, and dry throat may occur during lectures due to limited knowledge of vocal health strategies, inflamed vocal folds due to voice misuse, and poor hydration. The results also suggest that vocal health education alone does not aid in prevention. Because post-scores were higher across all measures, university professors may be at risk of developing a voice disorder. Higher post-scores indicate a need to develop a vocal health workshop to provide rapid application of preventive measures to reduce the increase in vocal symptoms throughout the teaching semester. While the findings contribute to the understanding of vocal health among university professors, several limitations are considered: 1) the study relied on self-reported symptoms, which may have influenced perceptions and introduced bias, and 2) the small sample size may not be representative of university professors. Despite the limitations, the increase in vocal symptoms suggests that vocal demands associated with teaching warrants further investigation.

## Future Research/Funding

**From Identifying Vocal Symptoms to Promoting Vocal Sustainability**

Grant-Funded Vocal Health Workshop
*"Your Voice is Currency: Building Vocal Intelligence, Strategy, and Sustainability for Faculty Voice Use"*
*-Dr. S. Gibson, CCC-SLP*

- Develop and implement a faculty vocal health workshop.
- Translate current findings into practical strategies for occupational voice use.
- Provide practical strategies for managing occupational vocal demands, including vocal load, early warning signs, vocal economy, hydration, and warm-up/recovery strategies.
- Incorporate demonstration, guided practice, self-reflection, and individualized action planning.
- Examine changes in vocal health knowledge, confidence, perceived relevance, and intention to implement vocal health practices following the workshop.
- Conduct a 4-month follow-up to explore implementation, adherence, and sustained vocal health practices.




**Expected Outcomes**: The intervention is expected to increase faculty knowledge, confidence, and perceived relevance of occupational vocal health. The workshop should strengthen the ability to implement vocal health strategies and promote sustained adoption of vocal health practices, with the long-term goal of developing sustainable vocal health programming for university faculty.

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## Acknowledgements

**This research study was supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center. Grant #T42OH008432**

# Academy Adaptations: Evaluating Health in Firefighter Recruits

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*Exercise Science, School of Human Services, College of Education, Human Services, Criminal Justice, and Information Technology, University of Cincinnati*

## Introduction

Firefighters are vital to ensuring public safety.[1]

Unfortunately, firefighters suffer high rates of fatal and nonfatal injuries while working.[1]

Fatal injuries are often linked to overexertion and strain on the job.[1,2]

In addition, non-fatal injuries are usually to the musculoskeletal system and the result of sprains and strains due to slips, trips, and falls.[3,4]

To prepare for a career in the fire service, there are extensive training requirements to ensure firefighter recruits are physically ready for the occupational demands.[5,6]

Although most fire academies have mandated physical training components, there is very little-known information on the physiological adaptations that may be occurring in firefighter recruits throughout the academy.[5,6]

## Purpose

**Primary Purpose:** The primary purpose of this study is to examine the effectiveness of the academy on cardiometabolic metrics (body composition, aerobic capacity, diet).

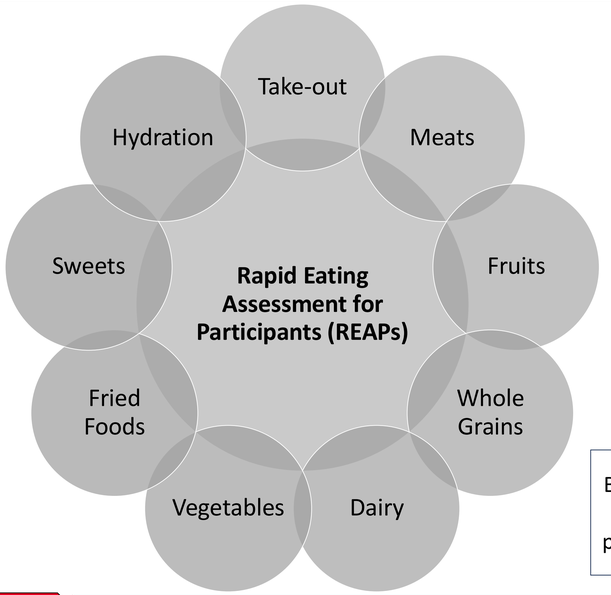
**Secondary Purpose:** A secondary aim of the study is to investigate adaptations to neuromuscular function (muscle size and quality, strength, balance) during the firefighter academy.

## Methods

Firefighter Training Program Classes

**~20 Students enrolled in the training program**

**Beginning and end of the semester testing sessions**

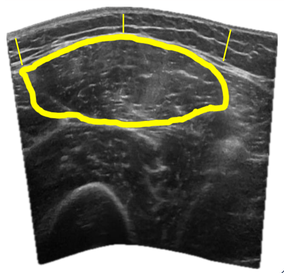


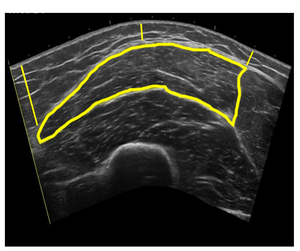




Body composition assessments of fat mass, lean mass, body fat percentage, and body mass index.

## Methods Continued





The rectus femoris and vastus lateralis will be measured at 50% of the length each respective muscle. Muscle size and quality will be assessed.

Maximal handgrip strength will be assessed with a handgrip dynamometer.

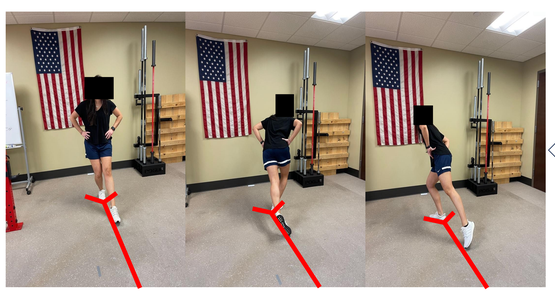


Aerobic capacity ($VO_2$max) will be estimated during a submaximal walking treadmill test.






Functional balance will be measured in the anterior, posteromedial, and posterolateral directions.



## Expected Results

**Primary Hypothesis:** It is hypothesized that students enrolled in the firefighter training program will improve body composition and aerobic capacity; however, will have poorer overall diets.

**Secondary Hypothesis:** It is also hypothesized that during the firefighter training program, students will improve muscle size, but not quality, improve strength, and have no significant changes to balance performance across the program.

## Conclusions and Future Directions

The current findings will allow for **insight into the health and fitness adaptations** that may or may not be occurring during fire training programs.

Administration in firefighter preparation programs want to revise **exercise testing and prescription as well as periodization within training** protocols.

## Acknowledgements

- The research team would like to thank the Cincinnati State Fire Service Technology Program and the administration for their continued support and collaboration.
- This research study was supported by the National Institute for Occupational Safety and Health through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42OH008432

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