Community Biomonitoring Update

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Presentation at the Scientific Guidance Panel Meeting

March 7, 2023

Overview of presentation

- Quick updates

Biomonitoring component of the **S**an **J**oaquin Valley **P**ollution and **H**ealth **E**nvironmental **R**esearch Study (**BiomSPHERE**)

Filtration for **R**espiratory **E**xposure to Wildfire **S**moke from **S**wamp **C**ooler **A**ir (**FRESSCA**) Mujeres project

- Initial biomonitoring results

Stockton **A**ir **P**ollution **E**xposure **P**roject (**SAPEP**)

- Recruitment and urine sample collection is underway
- Sample collection will continue through August/September 2023

More information

- Project page: https://biomonitoring.ca.gov/projects/biomsphere
- Prior SGP meeting presentations
  - March 2022: https://biomonitoring.ca.gov/sites/default/files/downloads/AB617UpdatePlanning032522.pdf
  - July 2022: https://biomonitoring.ca.gov/sites/default/files/downloads/CommunityBiomUpdate072222.pdf

FRESSCA
AIRE LIMPIO EN CASA
MUJERES

- Recruitment is underway
- Urine sample collection scheduled to begin in May 2023 and continue through October 2023

More Information:

- November 2022 SGP meeting presentation: https://biomonitoring.ca.gov/sites/default/files/downloads/FRESSCA_Mujeres111822.pdf
- Recruitment video: https://youtu.be/A6DSYFpMQu0

All Saints Academy of Stockton

Little Manila Rising

Stockton Air Pollution Exposure Project

Berkeley University of California

Biomonitoring California

cerch Center for Environmental Research & Children's Health

OEHHA California Office of Environmental Health Hazard Assessment

University of California Merced

UCSF University of California San Francisco

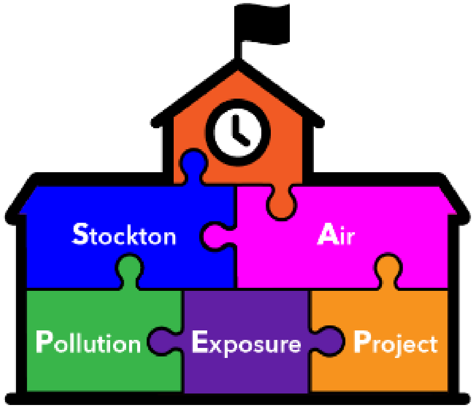
California Department of Public Health

Stockton Air Pollution Exposure Project (SAPEP)

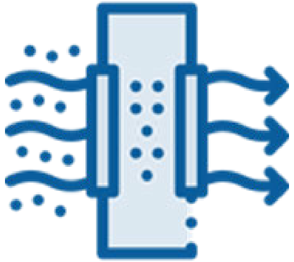
Learn more about air pollution exposures to schoolchildren in Stockton

Evaluate effectiveness of school air filtration at reducing children’s air pollution exposures

Overview of study elements



- Enrolled students from All Saints Academy of Stockton
- Measured air pollutant levels inside and outside of the school



- Installed standalone air filtration units in ~ half the classrooms of participating students
- Parents completed online questionnaires

- Collected children's urine before and after school
- Measured chemicals that indicate exposure to air pollution

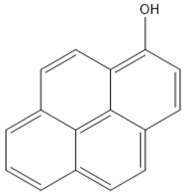
Sample collection

- Goal to enroll 50 children; actual enrollment = 18
- Total of 69 valid urine samples collected (~4 per child)
  - On two days of consecutive weeks in early December 2021
  - One sample before school, one sample after school

Laboratory analyses for biomarkers of exposure

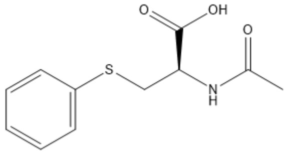
Hydroxy Metabolites of PAHs

- Naphthalene
- Fluorene
- Phenanthrene
- Pyrene



Stable Metabolites of VOCs

- Acrolein
- Acrylonitrile
- Benzene
- 1,3-Butadiene
- Crotonaldehyde
- Propylene oxide

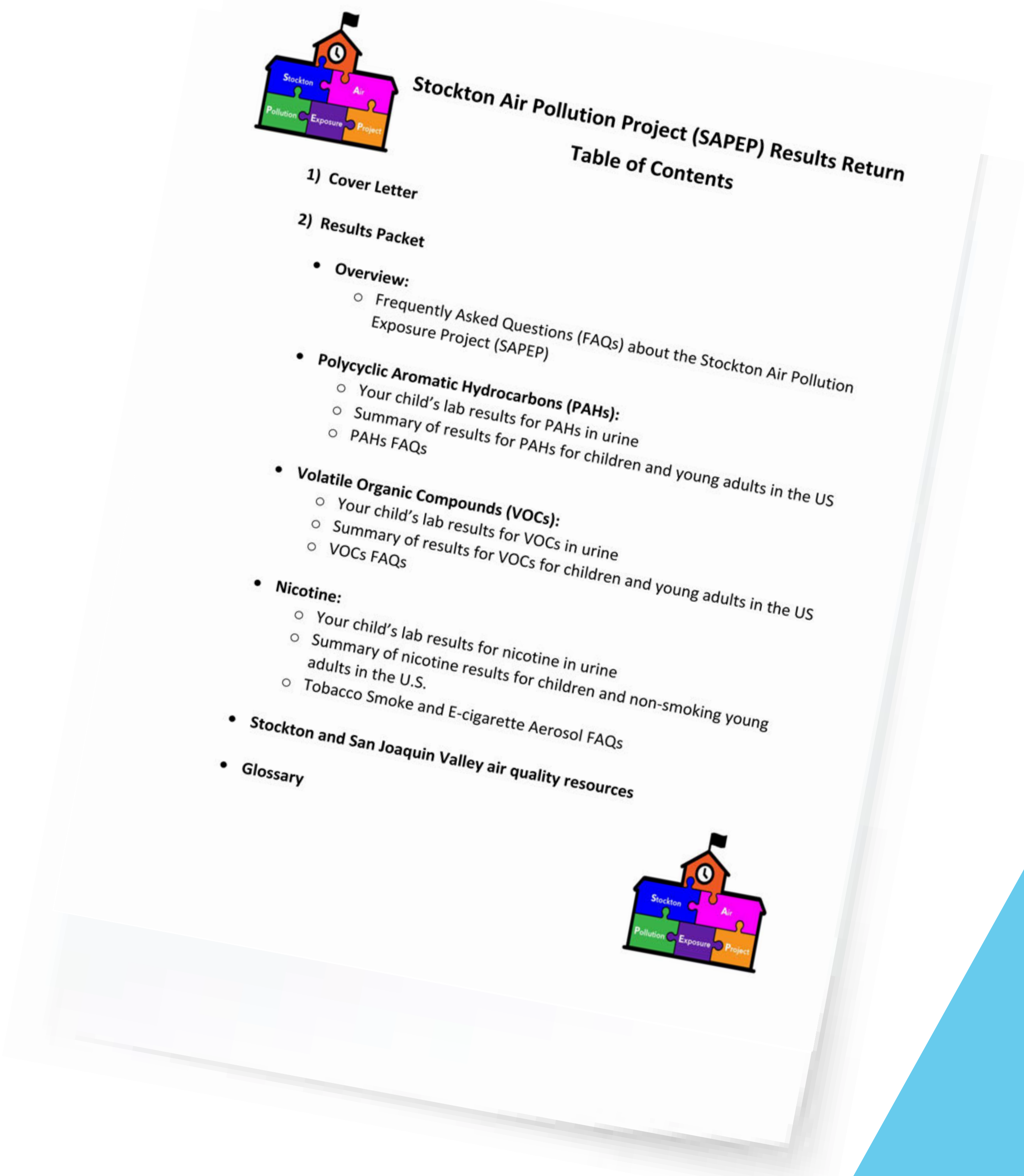


Measured by Clinical Pharmacology Laboratory at UCSF

- Jacob P, et al. Determination of Phenolic Metabolites of Polycyclic Aromatic Hydrocarbons in Human Urine as Their Pentafluorobenzyl Ether Derivatives Using Liquid Chromatography−Tandem Mass Spectrometry: https://pubs.acs.org/doi/10.1021/ac060920l
- Alwis KU, et al. Simultaneous analysis of 28 urinary VOC metabolites using ultra high performance liquid chromatography coupled with electrospray ionization tandem mass spectrometry (UPLC-ESI/MSMS): https://www.sciencedirect.com/science/article/abs/pii/S0003267012005363?via%3Dihub

Biomonitoring results return

- Individual urine results for VOC, PAH, and nicotine metabolites were sent to participants in February 2023
- Individual urine results for markers of oxidative stress and inflammation will be sent later in 2023



Stockton Air Pollution Exposure Project

Stockton Air Pollution Project (SAPEP) Results Return

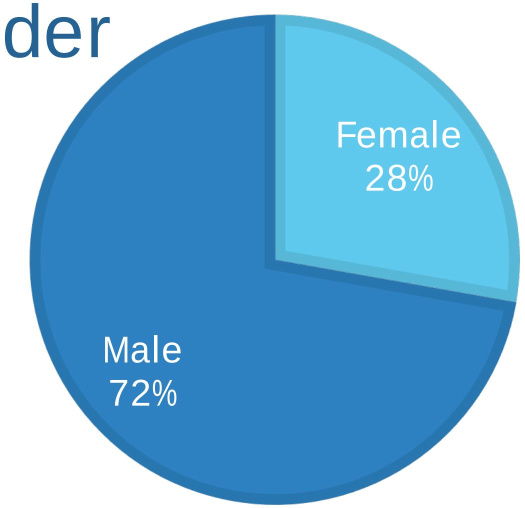
Table of Contents

1) Cover Letter
2) Results Packet
   - Overview:
     - Frequently Asked Questions (FAQs) about the Stockton Air Pollution Exposure Project (SAPEP)
   - Polycyclic Aromatic Hydrocarbons (PAHs):
     - Your child's lab results for PAHs in urine
     - Summary of results for PAHs for children and young adults in the US
     - PAHs FAQs
   - Volatile Organic Compounds (VOCs):
     - Your child's lab results for VOCs in urine
     - Summary of results for VOCs for children and young adults in the US
     - VOCs FAQs
   - Nicotine:
     - Your child's lab results for nicotine in urine
     - Summary of nicotine results for children and non-smoking young adults in the U.S.
     - Tobacco Smoke and E-cigarette Aerosol FAQs
   - Stockton and San Joaquin Valley air quality resources
   - Glossary

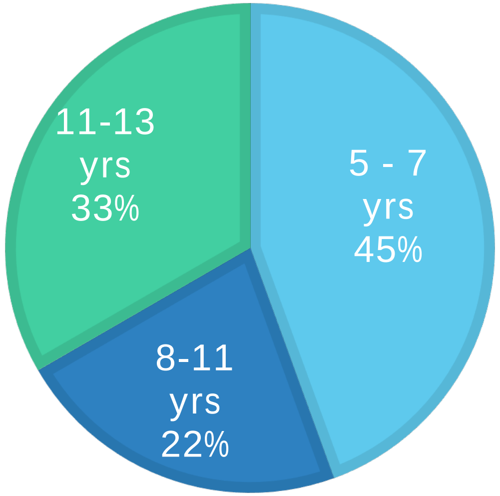
Stockton Air Pollution Exposure Project

Participant demographics (n=18)

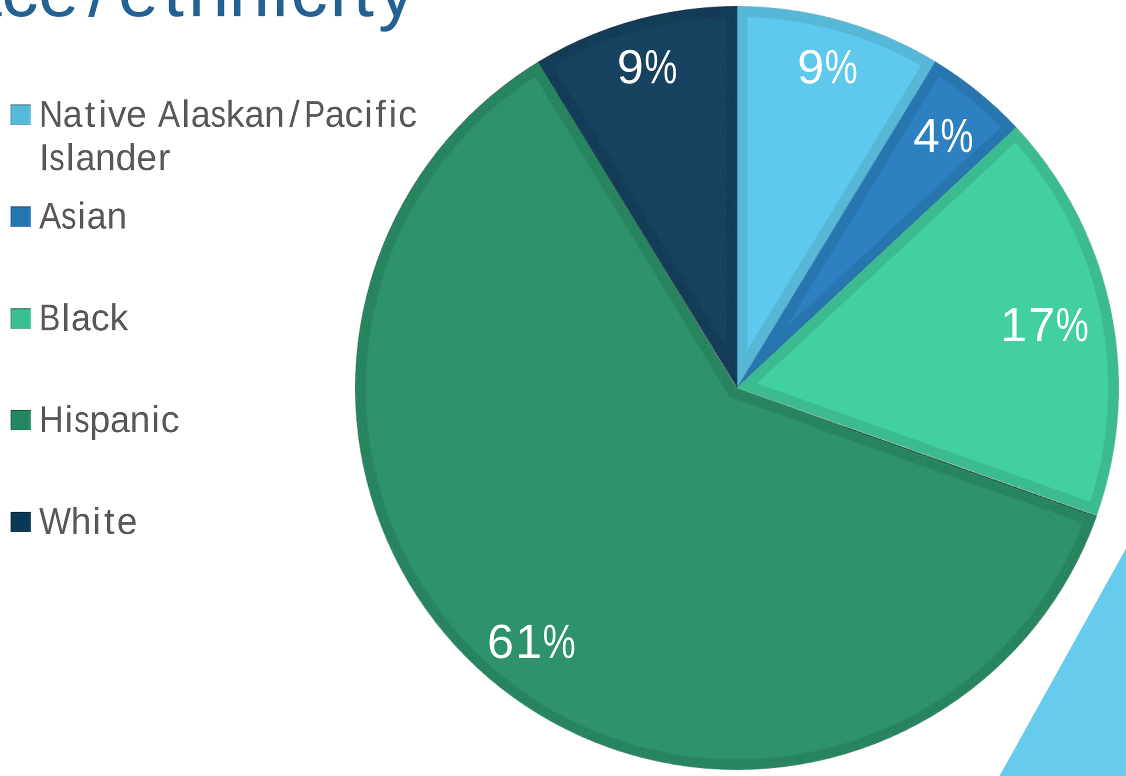
Gender



Age



Race/ethnicity



VOCs and PAHs: initial data analyses

- Calculated geometric means and 95% confidence intervals for all 69 samples, using a random effects model
- Compared metabolite levels to children in the National Health and Nutrition Examination Survey (NHANES), 2011-2012/2015-2016
- Considerations:
  - Small number of samples
  - Differences in levels of detection (LODs)
  - Lack of comparable contemporaneous NHANES data

Results: urinary VOC metabolites

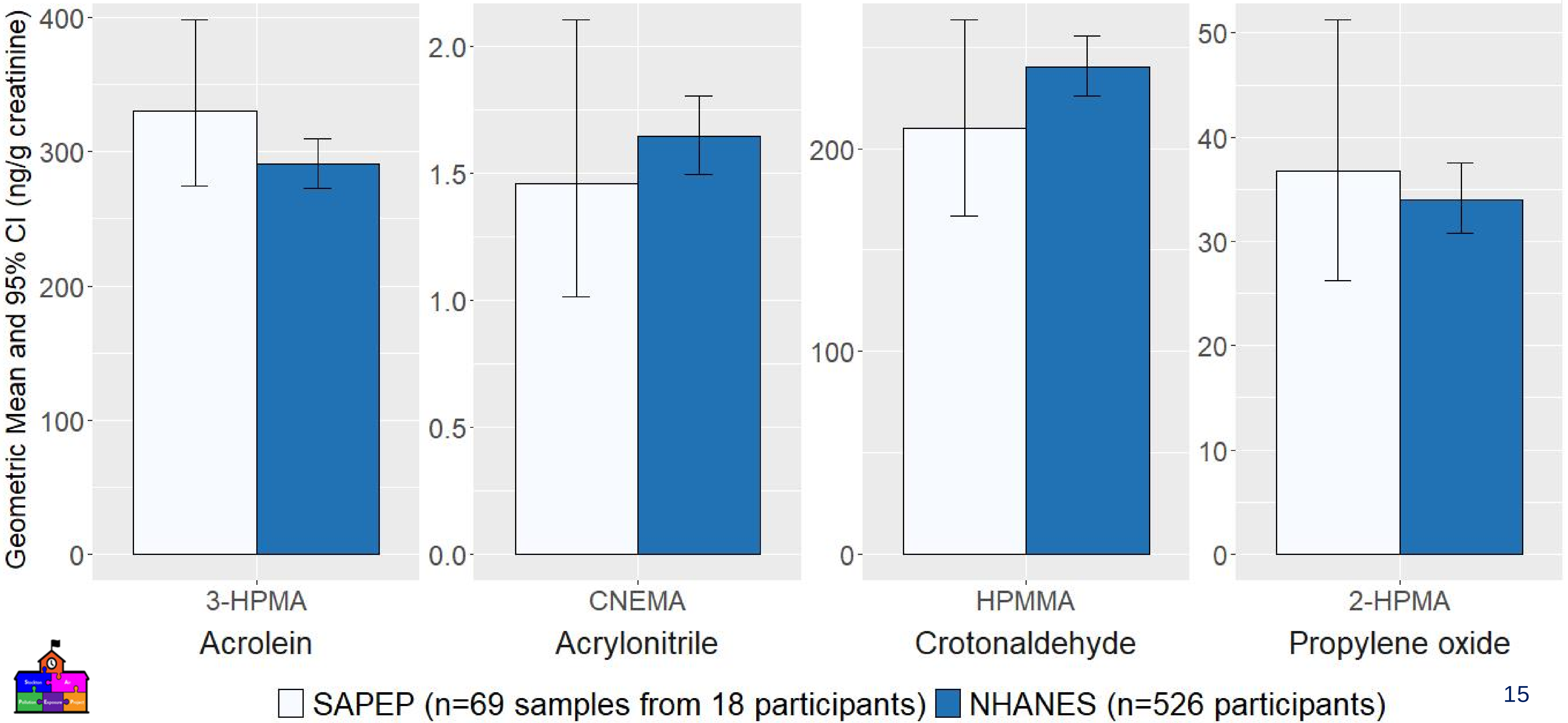
		SAPEP		NHANES	
Parent Chemical	Metabolite	Level of Detection	Detection Frequency	Level of Detection	Detection Frequency
Acrolein	3-HPMA	1 ng/mL	100.0%	13 ng/mL	99.6%
Acrylonitrile	CNEMA	0.5 ng/mL	88.4%	0.5 ng/mL	81.7%
Benzene	PMA	0.1 ng/mL	40.6%	0.6 ng/mL	50.4%
1,3-Butadiene	1- & 2-MHBMA	0.5 ng/mL	18.8%	0.7 ng/mL	1.6%
	3-MHBMA	0.1 ng/mL	14.5%	0.6 ng/mL	97.7%
Crotonaldehyde	HPMMA	1 ng/mL	100.0%	1.7 ng/mL	100.0%
Propylene oxide	2-HPMA	1 ng/mL	100.0%	5.3 ng/mL	93.7%

Results: urinary PAH metabolites

		SAPEP		NHANES	
Parent Chemical	Metabolite	Level of Detection	Detection Frequency	Level of Detection	Detection Frequency
Fluorene	1-Hydroxyfluorene	25 ng/L	60.9%	Not measured	
	2-Hydroxyfluorene	25 ng/L	97.1%	8 ng/L	99.8%
	3-Hydroxyfluorene	25 ng/L	85.5%	8 ng/L	99.5%
Naphthalene	2-Naphthol	250 ng/L	100.0%	90 ng/L	100.0%
Phenanthrene	1-Hydroxyphenanthrene	25 ng/L	98.6%	9 ng/L	99.8%
	2-Hydroxyphenanthrene	25 ng/L	76.8%	10 ng/L	95.0%
	3- & 4-Hydroxyphenanthrene	50 ng/L	88.4%	10 ng/L	97.2%
Pyrene	1-Hydroxypyrene	25 ng/L	78.3%	70 ng/L	73.6%

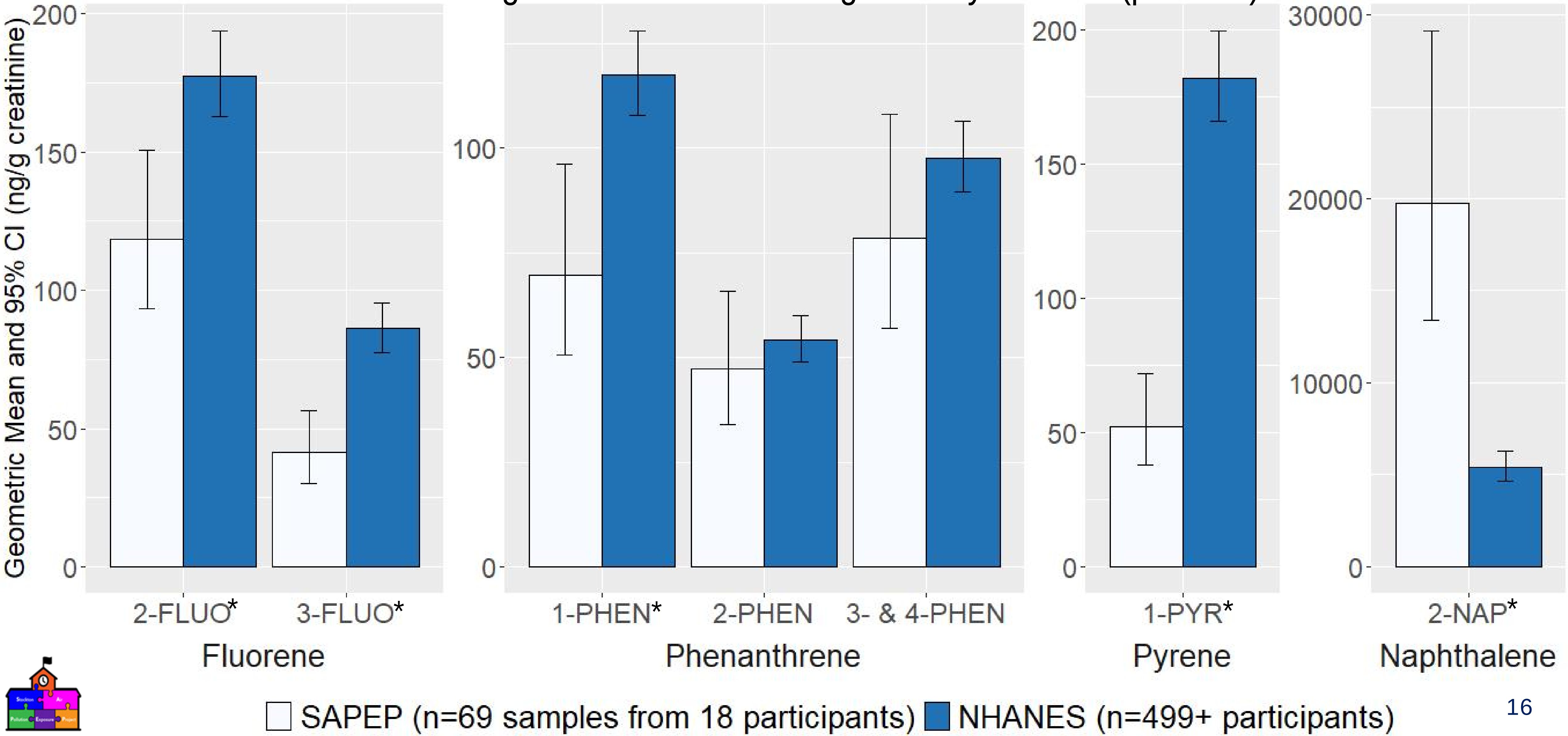
VOC metabolites: SAPEP vs. NHANES

Geometric means did not significantly differ for any of the metabolites (p > 0.05)



PAH metabolites: SAPEP vs. NHANES

* indicates geometric means are significantly different ($p < 0.05$)



Summary: VOC initial findings

- Nearly all SAPEP participants were exposed to acrolein, acrylonitrile, crotonaldehyde, and propylene oxide
- Exposures to benzene and 1,3-butadiene were comparatively less common
- Metabolite levels did not differ from NHANES

Summary: PAH initial findings

- Most SAPEP participants were exposed to fluorene, naphthalene, phenanthrene, and pyrene
- Metabolite levels were generally lower compared to NHANES*
- Exception: naphthalene metabolite level was significantly higher compared to NHANES*

* Note: comparisons made to 2015-2016 NHANES data; can not take into account recent temporal trends (if any exist)

Naphthalene: additional SAPEP findings

- High urinary 2-naphthol concentrations were:
  - Found in at least one urine sample of all SAPEP participants
  - Were not driven by tobacco or vaping-related exposures
- Air concentrations of naphthalene at SAPEP school were not especially high
- 2-naphthol co-eluded with 1-naphthol

Naphthalene findings: additional considerations

- U.S. and European biomonitoring surveillance data show urinary 2-naphthol levels are increasing
- Primary sources of naphthalene exposures include tobacco smoke, air emissions from fossil fuel combustion, and use of mothballs
  - Newer unrecognized sources of naphthalene may be emerging
- Other chemicals besides naphthalene may contribute to urinary 2-naphthol levels, as well as direct exposures to 2-naphthol

Naphthalene findings: next steps

- More detailed analyses of SAPEP data:
  - 2-naphthol urinary levels
  - Naphthalene air concentrations
  - Questionnaire data
- Consider other data sources:
  - Air emissions/environmental sampling data
  - Findings from other biomonitoring studies
- Literature review:
  - Pharmacokinetics of naphthalene
  - Specificity of 2-naphthol as a biomarker of exposure
  - Emerging sources of exposure concerns

SAPEP analysis: next steps

- Conduct integrated analyses of biomonitoring, air quality, and questionnaire data to:
  - Further characterize air pollutant exposures and potential predictors of exposure
  - Explore associations of the PAH and VOC metabolites with biomarkers of oxidative stress and inflammation
  - Evaluate the effectiveness of the school air filtration

Thank You!

Questions?