Traffic-Related Air Pollution and Biomarkers of Effect in Children in Fresno

John R. Balmes, MD

University of California, San Francisco and Berkeley

Disclosures

- I have no financial conflict of interest
- I am the Physician Member of the California Air Resources Board

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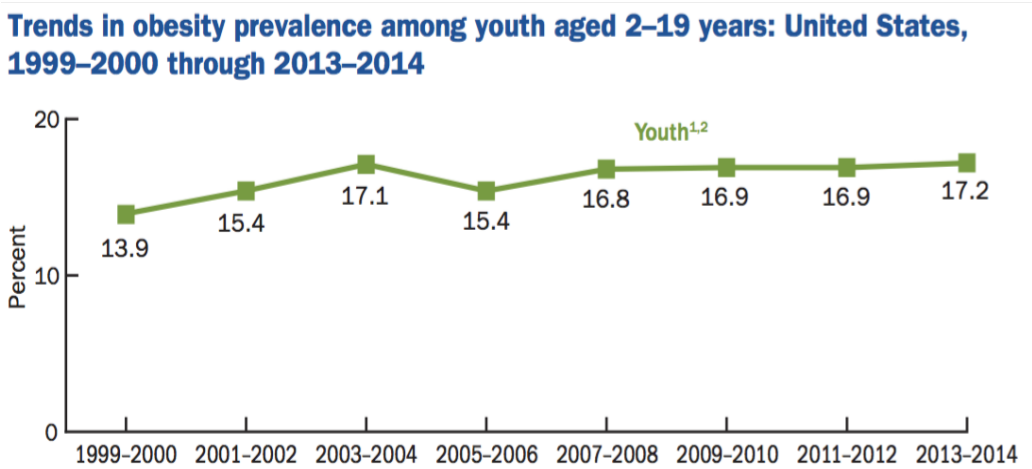
Epidemic of Obesity in U.S.

- 38% of Americans are overweight (BMI 25-29.9) and 35% are obese (BMI≥30)
- 17% of children (ages 2-19) are obese
  - Latino: 21.9%; African-American: 19.5%
  - ages 2-5: 8.9%
  - ages 6-11: 17.5%
  - ages 12-19: 20.5%



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Obesity Epidemic

- Thought to be due primarily to
  - increased caloric intake from high consumption of sugar-containing drinks and high-caloric-density fast food
  - decreased energy expenditure from a sedentary lifestyle
- Animal evidence suggests that chemicals in the environment may be “obesogens”
  - Organochlorines
  - Bisphenol A

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Other Environmental Exposures and Obesity

- Dietary composition
- Gut microbiome
- Built environment through its role in exercise and food consumption
- ? Exposure to ambient air pollutants
  - ? *in utero/early childhood*

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Air Pollution and Obesity

Several studies of children in LA and NYC have shown associations with traffic-related air pollution (TRAP)

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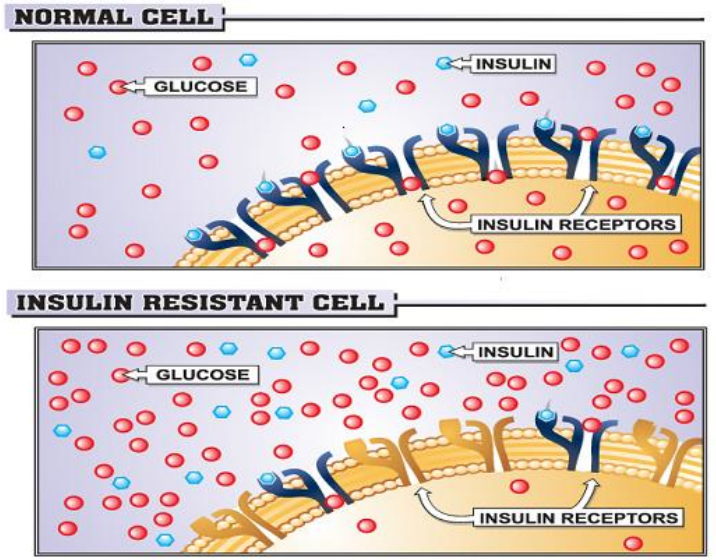
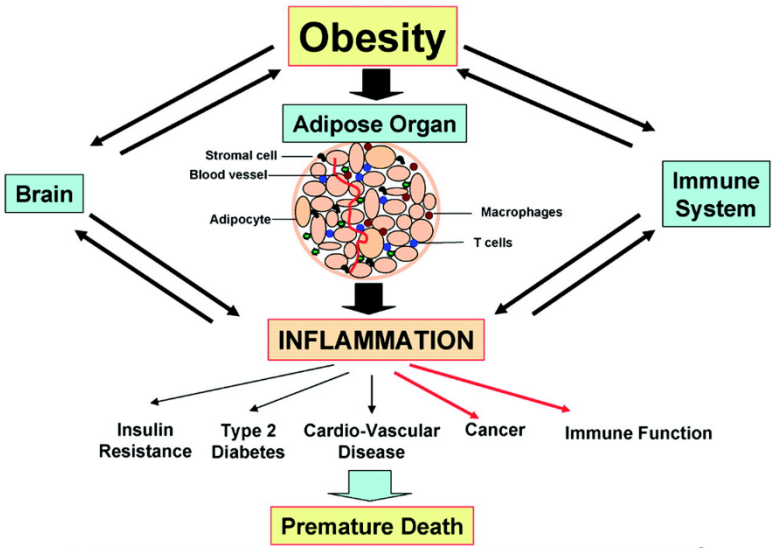
Linkage of Diabetes and Obesity

- Type 2 diabetes is a disorder of glucose metabolism
  - the body's cells fail to take up glucose from the blood due to insulin resistance
- 80% of those who develop type 2 diabetes are obese
  - obesity is associated with insulin resistance and β-cell failure
- Both diabetes and obesity are associated with increased systemic inflammation





Air Pollution and Diabetes

- Several studies have shown associations between diabetes in adults and exposure to traffic-related air pollution (TRAP)
- Recent studies from USC showed TRAP exposure in minority children was associated with higher fasting glucose and insulin resistance

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Potential Mechanism

- Air pollution can induce oxidative stress and systemic inflammation
- Exposure to fine particles induced fat tissue inflammation and insulin resistance in a mouse model of diet-induced obesity
- Hypothesis:
  - Exposure to air pollution *in utero* and in early childhood increases risks of abnormal glucose metabolism and obesity in later childhood

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Fresno Air Pollution

Rank Among All US Cities for Unhealthy Air

Metro Area	Ozone Rank	Particle Rank
Bakersfield	2	1
Fresno-Madera	3	2 (tie)
Visalia-Porterville-Hanford	4	2 (tie)
Modesto-Merced	6	4

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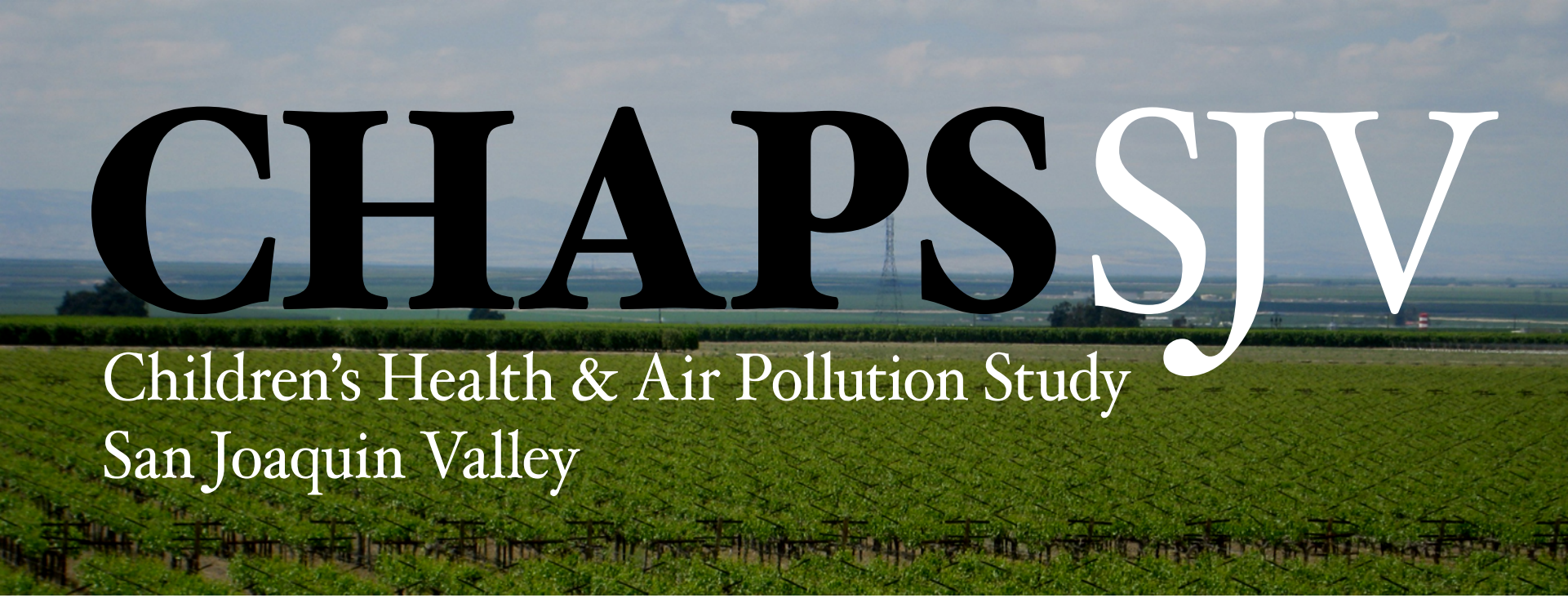

Does Air Pollution Contribute to Obesity and Glucose Dysregulation in Children?

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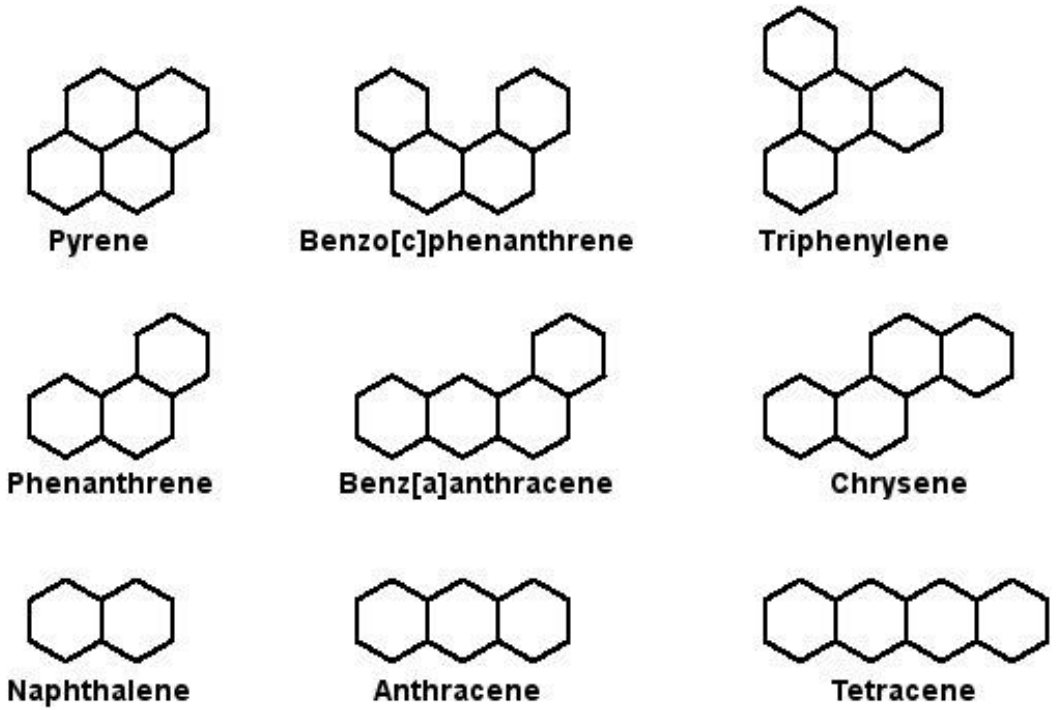
Polycyclic Aromatic Hydrocarbons (PAHs)

- PAHs are formed by incomplete combustion of carbon-containing materials (wood, coal, diesel, gas; also cooked food and tobacco smoke)



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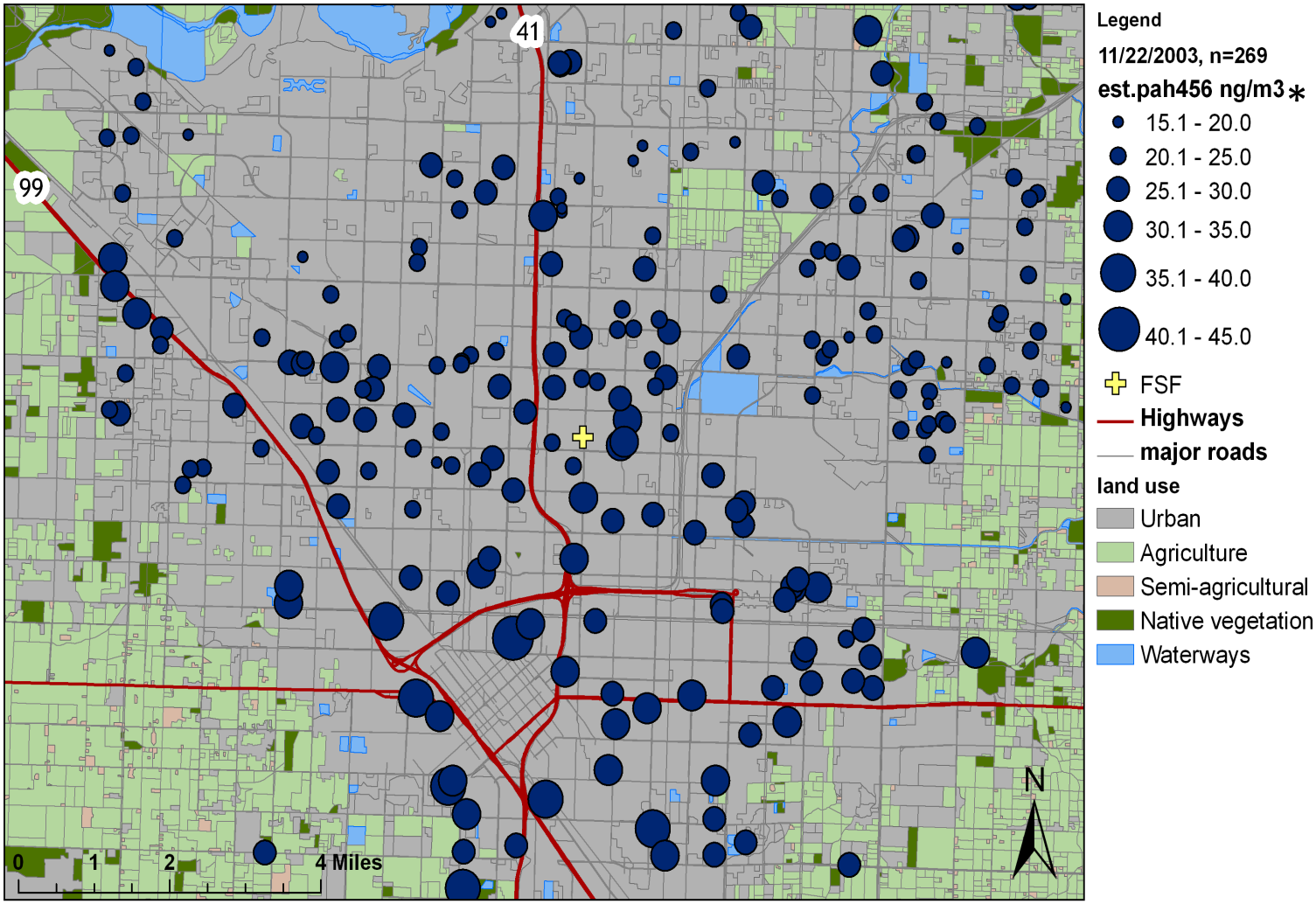
PAH cumulative exposure in Fresno



*PAH456 = PAHs with 4, 5, or 6 rings

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Research Question

- Are exposures to ambient air pollutants, especially PAHs, associated with:
  - increased BMI
  - biomarkers of oxidative stress, systemic inflammation, and abnormal fat and glucose metabolism
  - increased blood pressure

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CHAPS Study Design

- Birth cohort, including cord blood; annual visit ages 1 and 2; n=200)
- Child cohort (age 7, follow-up visit at age 9; n=300)
- For all participants
  - Anthropometry and biomarker measurements
  - Estimated air pollution exposure (elemental carbon [EC], nitrogen dioxide [NO_2], nitrogen oxides [NO_x], PAH456*, fine particulate matter [$PM_{2.5}$], and carbon monoxide [CO])

*PAHs with 4, 5, or 6 rings.

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Description of Child Cohort (n=299)

Characteristic	Mean (SD)	%
Age (months)	95.6 (7.0)	
Weight (kg)	31.5 (8.8)	
Male		53.2
Race/Ethnicity		
Hispanic/Latinx		79.6
Black		11.4
Non-Hispanic White		6.0
Asian/Pacific Islander		3.0
Primarily Spanish-speaking		17.4
Renter*		78.0
Annual household income <$15K*		28.0
Obese**		24.8
Overweight**		16.1

*Responses were refused, not applicable or unknown for n=3 for each of the home renting and household income questions **Using age-and sex-specific percentiles of the 2000 CDC growth charts, obese was defined as BMI ≥ 95th percentile and overweight was defined as BMI 85th to <95th percentiles.

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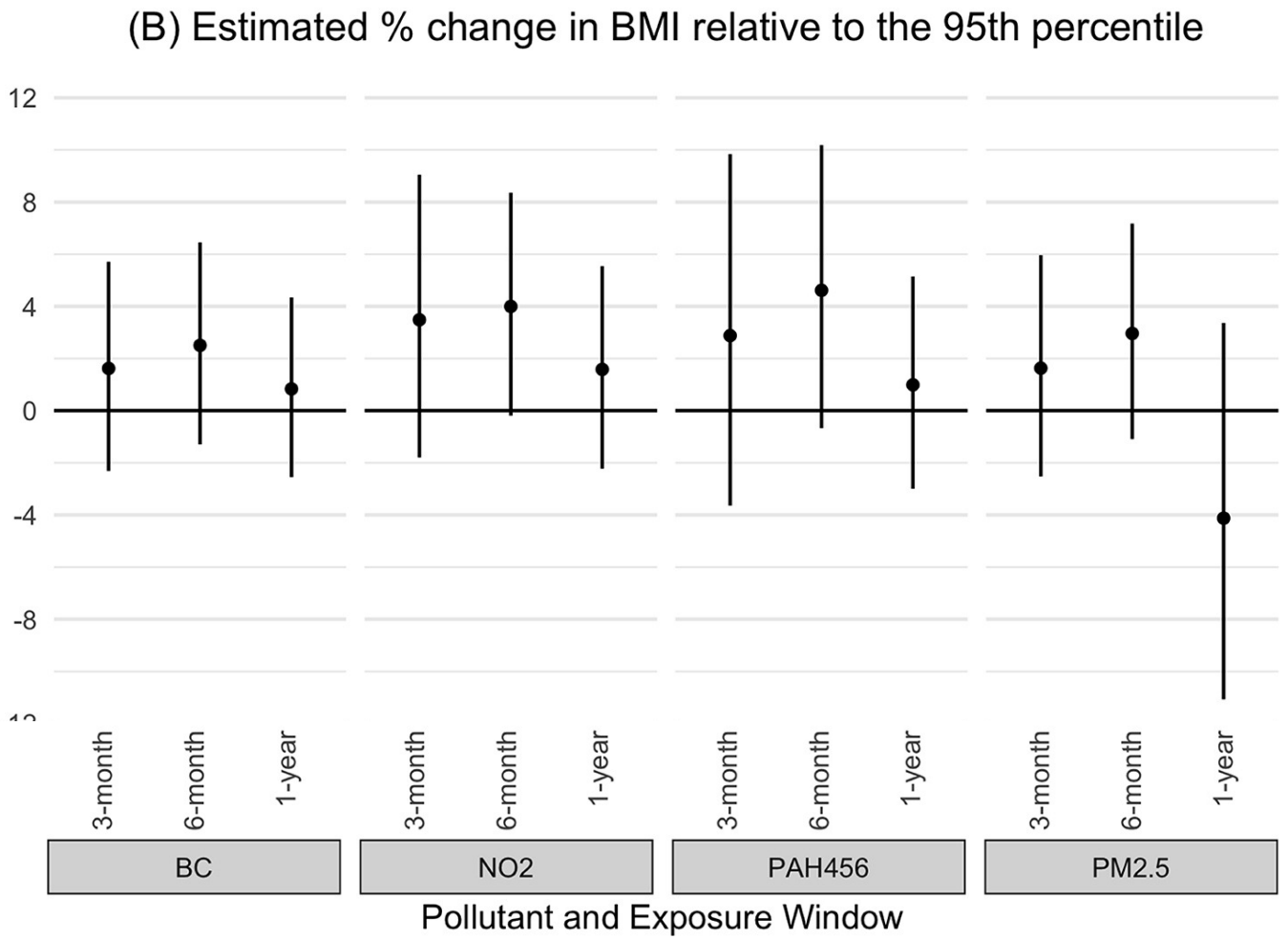
BMI-percentile



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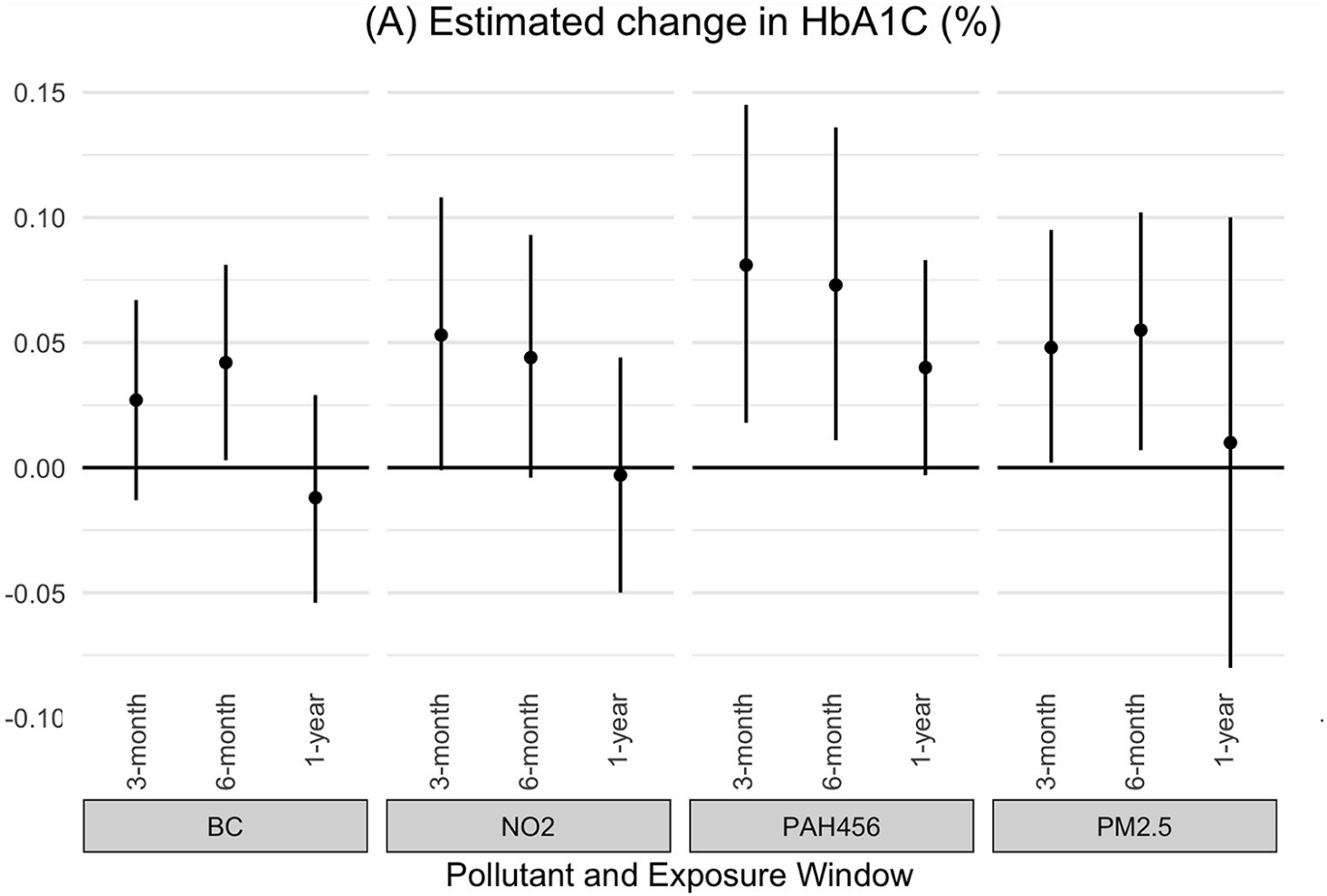
Hemoglobin A1c



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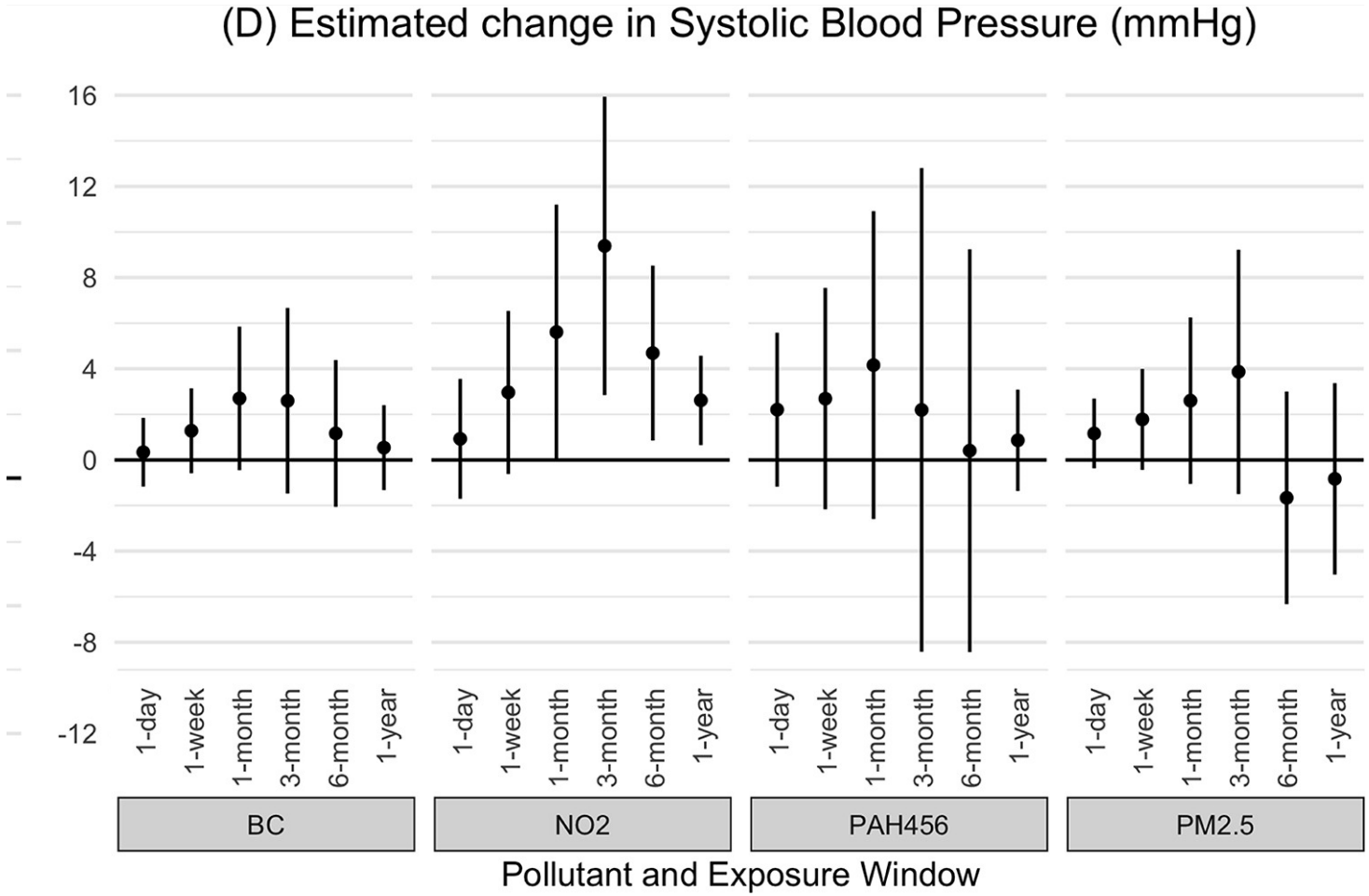
Systolic Blood Pressure



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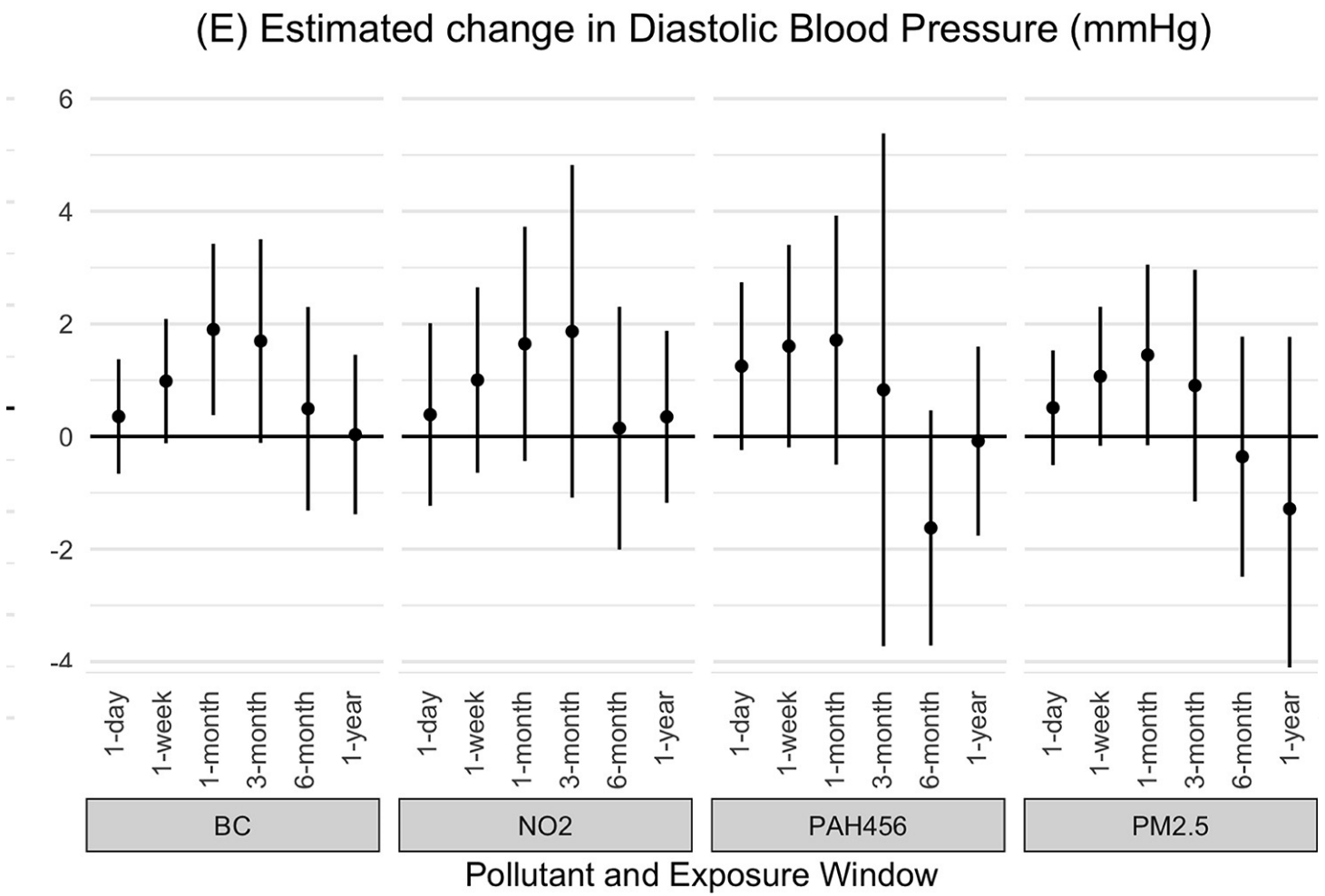
Diastolic Blood Pressure



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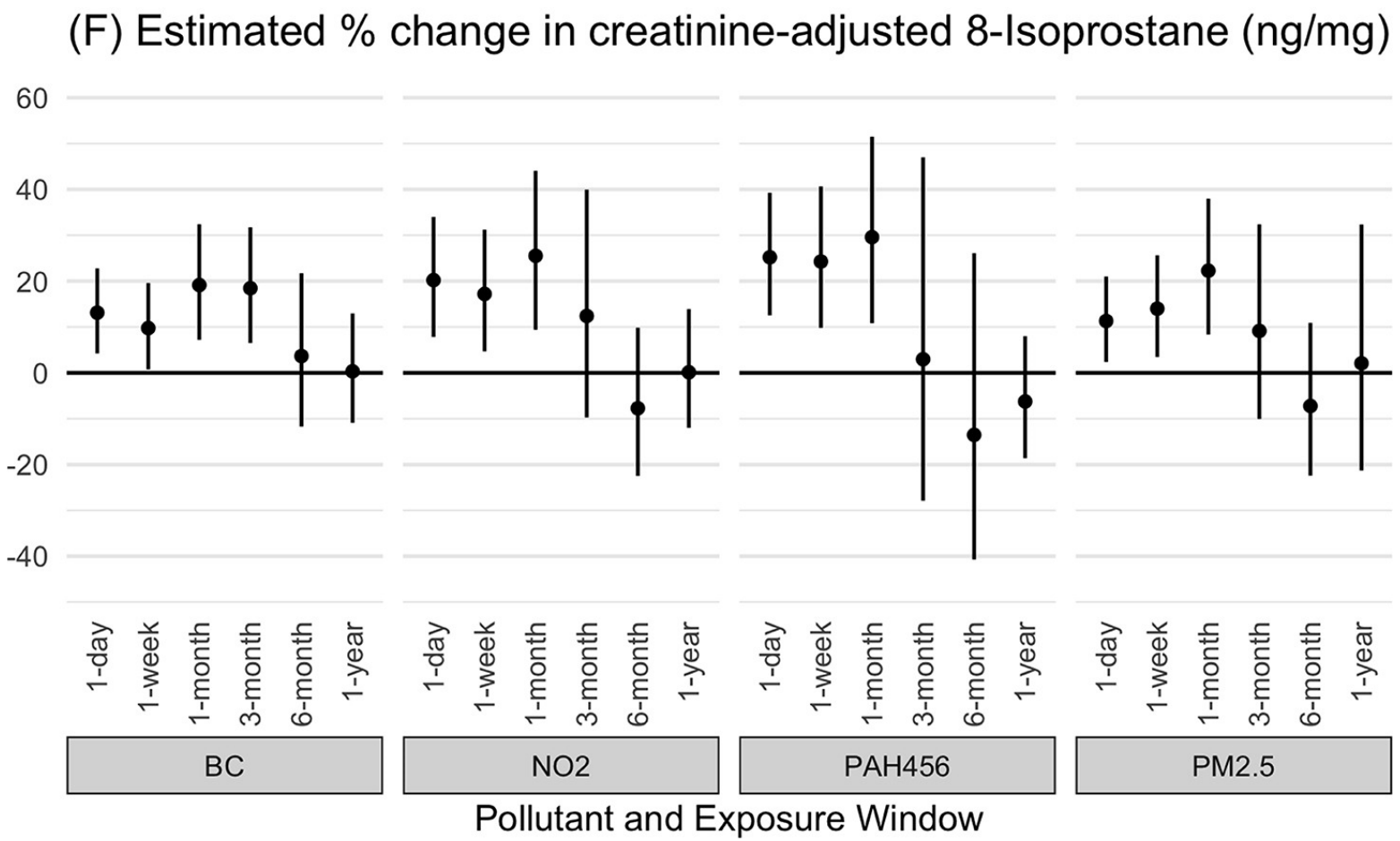
Urinary 8-isoprostane



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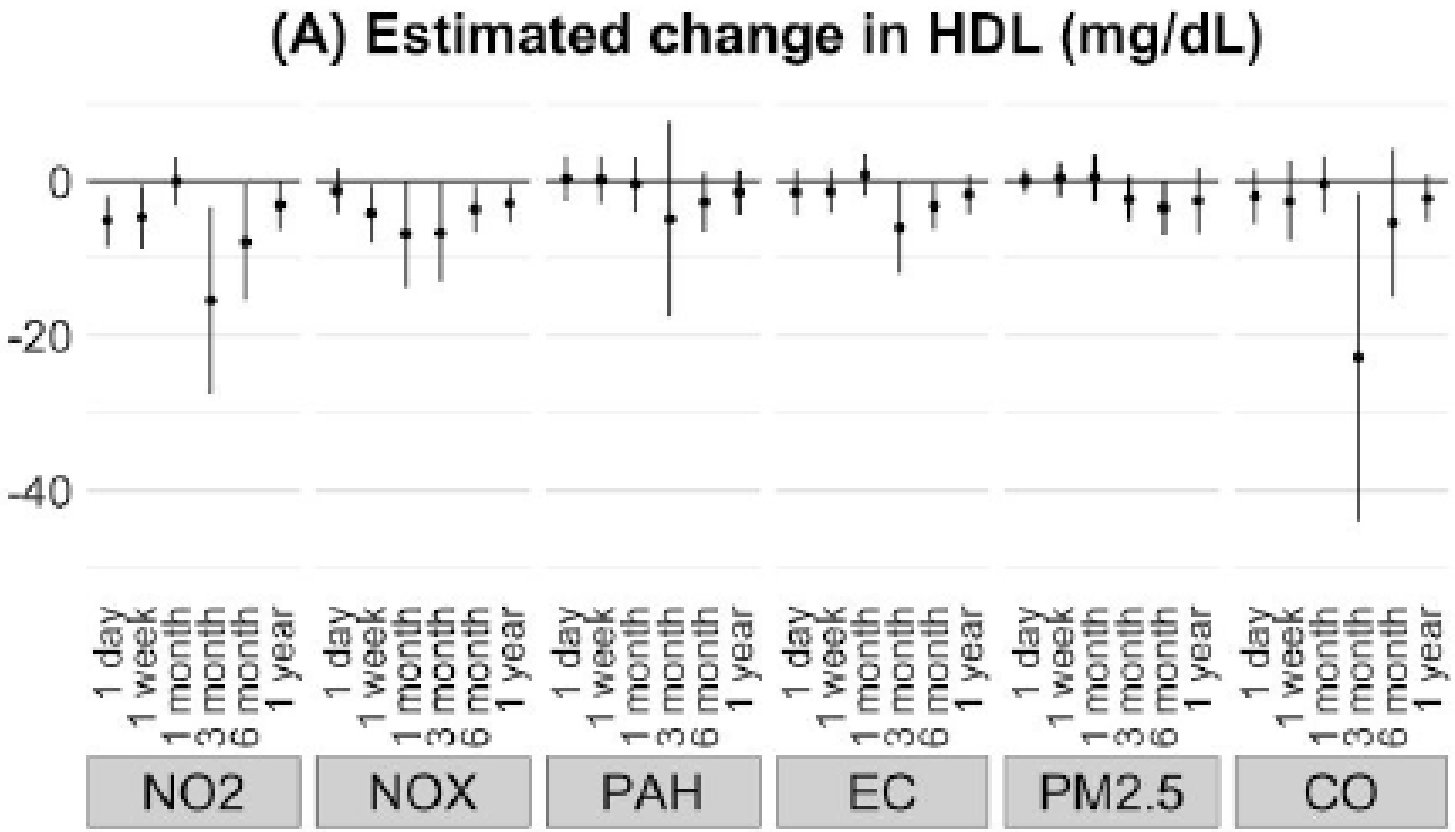
High-Density Lipoprotein (Age 9, n=182)



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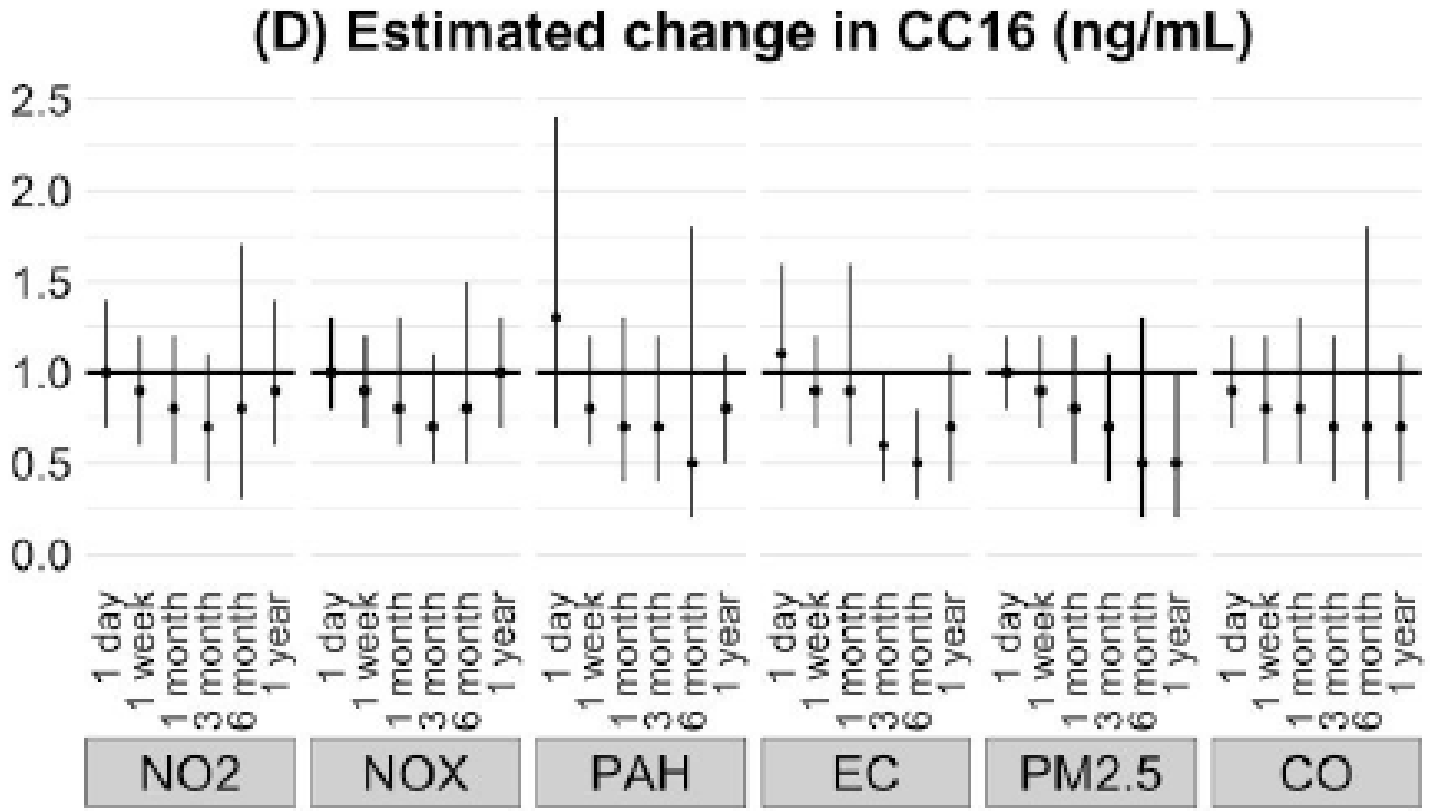
Urinary Club Cell Protein-16 (Age 9, n=122)



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Summary

- The prevalence of both obesity and pre-diabetes is high among Latinx youth in the SJV
- Air pollution may increase the risk of both conditions by inducing oxidative stress, airway inflammation, and ? systemic inflammation
- Childhood exposure to TRAP is associated with outcomes consistent with increased risk of metabolic syndrome (BMI,HbA1c, HDL, and BP)

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