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The Association between Particulate Matter (PM) Components and Human Health with Focus on Organic Components

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2013 EMEP Conference
Albany, NY
November 6, 2013

Motivation and Objectives

- Role of $PM_{2.5}$ in health studies
- $PM_{2.5}$ a complex mixture
- Need for assessing role of components
  - NAS report
  - Value
- Objective: define role of components from published literature; what can we say about organics?

Approach

- Reviewed literature through February 2012
- Epidemiology, toxicological, human clinical studies
- Acute studies only (exposures ≤ 1 week)
- No judgments about study methods, analyses
- Studies had to consider at last 2 components and $PM_{2.5}$
- Quantitative results were presented
- Considered most significant positive result

Results

- Identified 49 independent epidemiological studies
  - Mortality
  - Morbidity
  - Cardiovascular
  - Respiratory including asthma
  - Considered most often: sulfates, carbon-containing species

Results – Epidemiological Studies Overall

- 39 studies considered $PM_{2.5}$ and at least 2 components

  21/39 significant association and at least with PM or component

  2/39 significant association with PM, but not component

  17/39 significant association with components, but not PM

  Carbon-containing components gave more significant associations than $PM_{2.5}$

- CVD response

  24/28 studies considering carbon-containing particles found significant associations

  9/35 studies considering sulfates found significant associations

Results Epidemiological Studies II

- Respiratory responses
  - 15/26 studies for carbon-containing particles
  - 12/27 studies for sulfates
- Asthma
  - 7/20 studies for carbon
- Not much consideration of metals in epi studies
  - Ni, V, Cu, Si, K found greatest effects

Toxicological Studies

Overall

20 studies considered

- 14 in vivo CAPS studies
- 6 in vitro studies using collected PM
- V, Ni most frequently indicted

– All 20 studies showed some significant effect

- 5/20 for PM and component
- 15/20 for components only
- 10/20 indict some carbon
  - 7/15 with EC/OC
  - 5/15 with OC
- 7/18 indict sulfur

Overall Conclusion

- No major component is exonerated
- More evidence for carbon-containing particles
  - Definition needs to be clarified
- Some concern for metals, especially Ni, V with cardiovascular and respiratory; Al, Si with respiratory endpoints

Limitations/Caveats

- Considered any significant positive results
- Methodologies not evaluated
- No consideration of measurement error
- Multiple comparison issue
- Surrogacy issue

Health Analyses of Thermal Desorption Data (Organic PM Species)

Atlanta & Birmingham (2006 - 2009), Dallas (2006 – 2007)

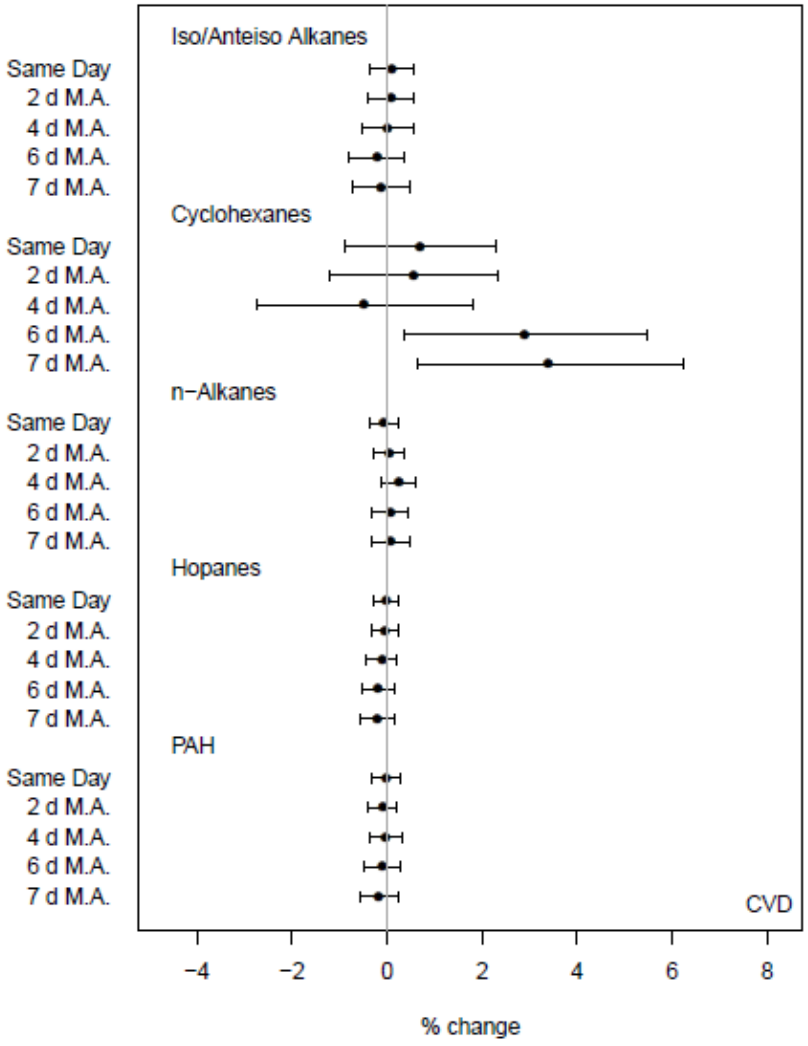
Health Data:

- Medicare enrollees (>64 yr)
- Total emergency CVD and respiratory related hospital admissions

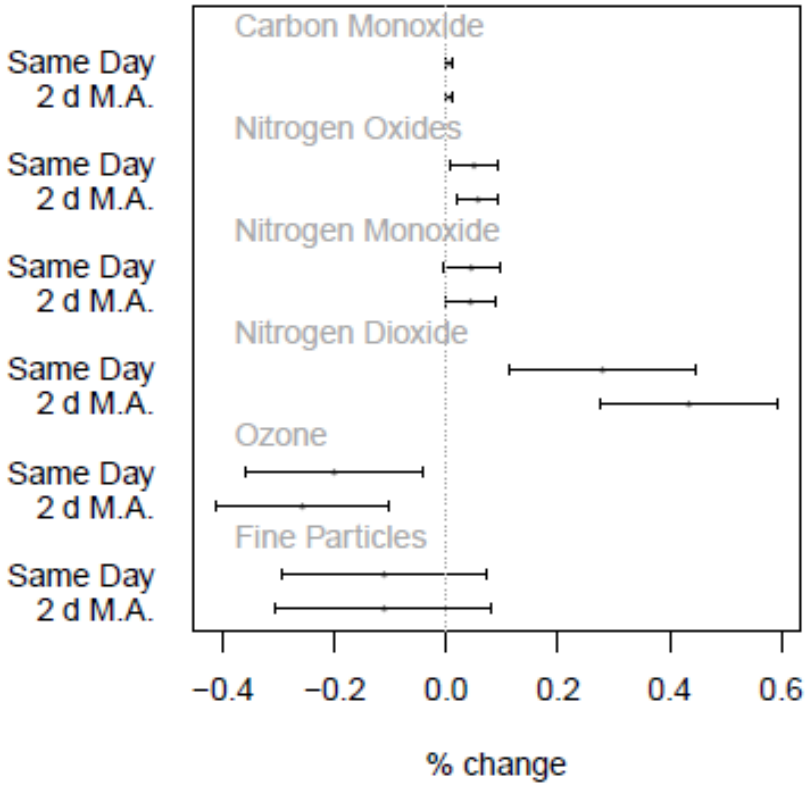
Air Pollution Data:

- $PM_{2.5}$ condensed-phase primary OC species (TD-GCMS) grouped by their chemical structure
  - At least 75% non-missing observations
  - At least 50% above the LOD
  - IQR/median > 0.3
  - All criteria satisfied in all 3 cities

Thermal Desorption Data: Atlanta, Birmingham, Dallas Combined Total CVD



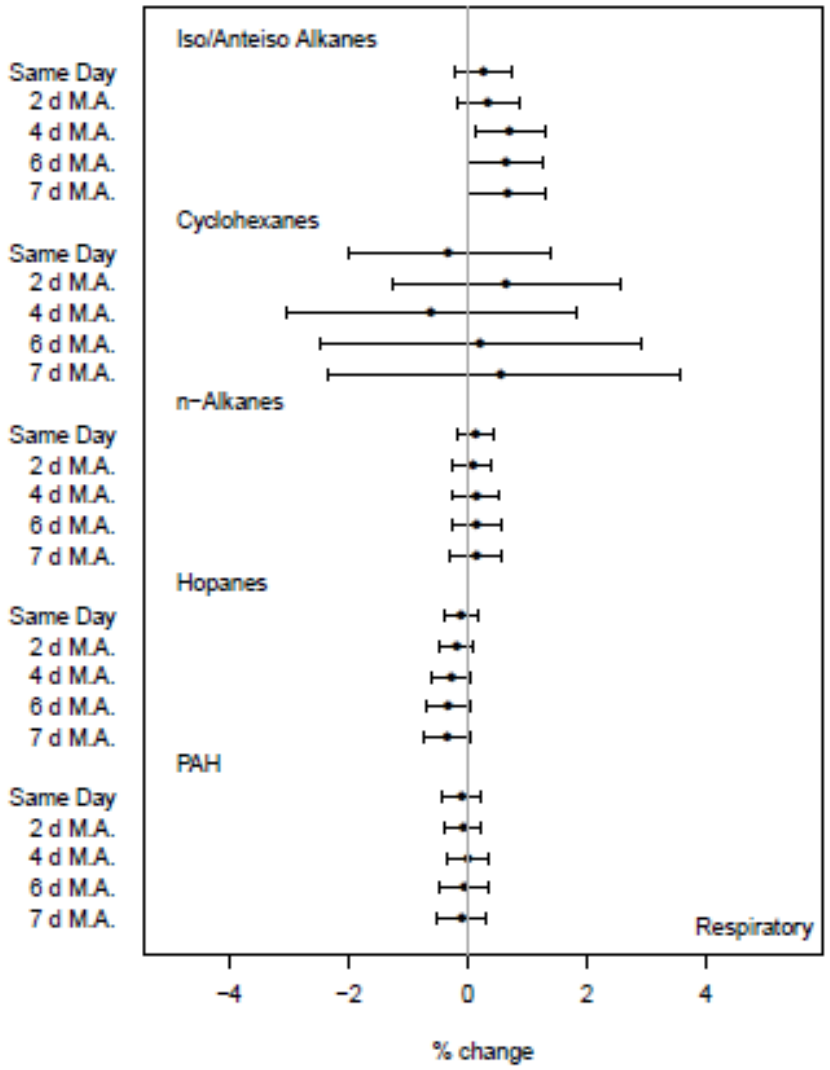
Comparable Results for Atlanta, Birmingham Total CVD



Preliminary results

Results: All 3 Cities

Total Respiratory:



Thermal Desorption Data

Iso-/anteiso-alkane and alkane exposures associated with increased odds of respiratory admissions

- strongest association for pneumonia

Exposures to cyclohexanes are consistently associated with increased rate of CVD admissions

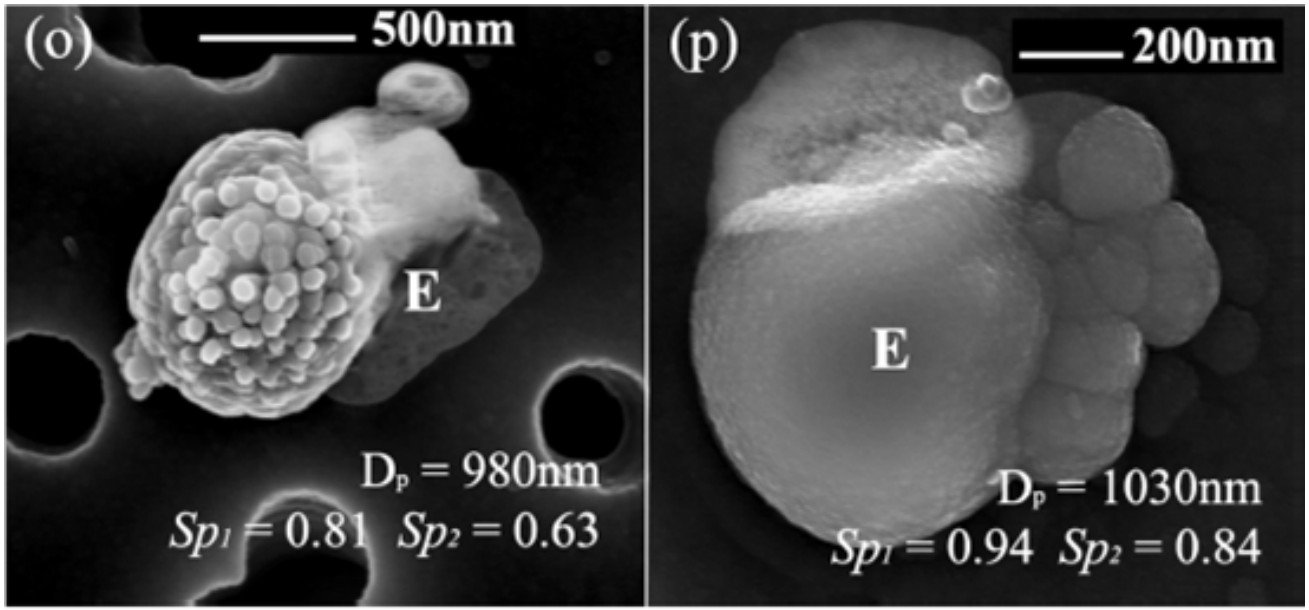
- Cyclohexane effects have not been examined before
- Mobile source emissions linked to cyclohexanes

Implication of Organic Particle Analyses

- All organics are not equally toxic
- Danger of using EC/OC as generic indicators
- Need to replicate
- New York State implications

Caveat

- One study does not a conclusion make



Questions?