Traffic-related Air Pollution Exposure During Pregnancy and Preterm Birth

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Air Pollution

• Regulated by U.S. EPA
  ▫ Carbon monoxide (CO)
  ▫ Nitrogen dioxide (NO₂)
  ▫ Particulate matter (PM_{10}, PM_{2.5})

• Traffic exposure
  ▫ Traffic density
Particulate Matter

- **PM$_{2.5}$**: Combustion particles, organic compounds, metals, etc. < 2.5 μm (microns) in diameter
- **PM$_{10}$**: Dust, pollen, mold, etc. < 10 μm (microns) in diameter
- **Human Hair**: 50-70 μm (microns) in diameter
- **Fine Beach Sand**: 90 μm (microns) in diameter

*Image courtesy of the U.S. EPA*
Counties that do not meet the annual PM$_{2.5}$ Standard

66 counties don’t currently meet 12 ug/m$_3$

EPA will not decide who needs to improve air quality to meet the standard until 2014 at the earliest. States will have until 2020-2025 to meet the standard.
Air Pollution & Preterm Birth

Traffic-related air pollution

- Carbon Monoxide (CO)
- Nitrogen Dioxide (NO₂)
- Particulate Matter < 10 and 2.5 μm (PM₁₀, PM₂.₅)

Traffic Density (within 300m)

Preterm birth

- Birth at... 34-36 weeks gestation (8%)
- 32-33 weeks gestation (2%)
- 28-31 weeks gestation (1%)
- 20-27 weeks gestation (1%)

N=250,000 2000-2006
Exposure to the highest quartile in the 2nd trimester (weeks 14-26)

<table>
<thead>
<tr>
<th>Gestational age (weeks)</th>
<th>N</th>
<th>Odds Ratio</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CO</td>
</tr>
<tr>
<td>37-42 (term)</td>
<td>232,241</td>
<td>1.0</td>
</tr>
<tr>
<td>34-36</td>
<td>22,321</td>
<td>1.1</td>
</tr>
<tr>
<td>32-33</td>
<td>4,011</td>
<td>1.2</td>
</tr>
<tr>
<td>28-31</td>
<td>2,938</td>
<td>1.2</td>
</tr>
<tr>
<td>24-27</td>
<td>1233</td>
<td>1.8</td>
</tr>
<tr>
<td>20-23</td>
<td>460</td>
<td>1.6</td>
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</table>
Preterm Birth & PM$_{2.5}$

![Graph showing the relationship between gestational age and odds ratio for preterm birth with PM$_{2.5}$ exposure. The graph indicates different trimesters and their corresponding odds ratios at various gestational ages.]
Preterm Birth & PM$_{10}$

![Graph showing odds ratio vs gestational age (weeks) with trimester markers.](image-url)
Multi-pollutant Score

- Number of exposures in the highest quartile of...
  - CO
  - NO$_2$
  - PM$_{10}$
  - PM$_{2.5}$
  - traffic density
Multi-pollutant score for 2\textsuperscript{nd} trimester

34-36 weeks
Multi-pollutant score for 2\textsuperscript{nd} trimester

![Graph showing multi-pollutant score for 2\textsuperscript{nd} trimester with data points for 34-36 weeks and 32-33 weeks. The x-axis represents weeks (32-33, 34-36) and the y-axis represents the score ranging from 0.75 to 3.00. The graph includes error bars indicating variability.]
Multi-pollutant score for 2\textsuperscript{nd} trimester

- 34-36 weeks
- 32-33 weeks
- 28-31 weeks

Weeks:
- 34-36 weeks
- 32-33 weeks
- 28-31 weeks
Multi-pollutant score for 2\textsuperscript{nd} trimester

![Graph showing multi-pollutant score for 2\textsuperscript{nd} trimester with different data points for 34-36 weeks, 32-33 weeks, 28-31 weeks, and 20-27 weeks.]
Role of Neighborhood SES

- Odds ratio of birth at 20-27 weeks for each exposure during the 2nd trimester of pregnancy

- *defined as those living in a block group with >10% unemployment, >15% with income from public assistance and >20% families below poverty level
Exposure to airborne polycyclic aromatic hydrocarbons during pregnancy and risk of preterm birth

Amy M. Padula a,*, Elizabeth M. Noth b, S. Katharine Hammond b, Fred W. Lurmann c, Wei Yang a, Ira B. Tager b, Gary M. Shaw a

<table>
<thead>
<tr>
<th>PAH exposure period</th>
<th>34-36 weeks</th>
<th>32-33 weeks</th>
<th>28-31 weeks</th>
<th>20-27 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire Preg</td>
<td>OR</td>
<td>OR</td>
<td>0.76</td>
<td>0.51</td>
</tr>
<tr>
<td>1st trimester</td>
<td>0.92</td>
<td>0.87</td>
<td>0.56</td>
<td>0.42</td>
</tr>
<tr>
<td>2nd trimester</td>
<td>0.98</td>
<td>1.03</td>
<td>1.02</td>
<td>1.10</td>
</tr>
<tr>
<td>3rd trimester</td>
<td>1.00</td>
<td>0.99</td>
<td>1.00</td>
<td>NC</td>
</tr>
<tr>
<td>Last 6 wks</td>
<td>0.96</td>
<td>0.97</td>
<td>0.86</td>
<td>2.74</td>
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</table>

<table>
<thead>
<tr>
<th>PAH Level</th>
<th>OR</th>
<th>95% CI</th>
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<tbody>
<tr>
<td>2nd quartile</td>
<td>1.49</td>
<td>1.08</td>
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<tr>
<td>3rd quartile</td>
<td>2.63</td>
<td>1.93</td>
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<tr>
<td>4th quartile</td>
<td>3.94</td>
<td>3.03</td>
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Next Steps

- Diabetes/Hypertension
Acknowledgements

- Gary Shaw
- Wei Yang
- Fred Lurmann
- Tracey Woodruff
- Rachel Morello-Frosch
- S. Katharine Hammond
- John Balmes
- Betsey Noth
- Ira Tager
- Kathleen Mortimer

**Funding**

- NIEHS R00ES021470
- NIH UG3 OD023272
Questions???