The Effect of Residential Endotoxin and Particulate Exposure on the Activity Levels of Asthmatic Children

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Overview

• Purpose
• Background
• Methods
• Results
• Conclusions
• Limitations
Purpose
• To evaluate the relationship between both dust endotoxin levels and airborne particulate count concentrations in the residential environment and activity limitation in asthmatic children
Background
Particulates and Asthma

- Airborne particulate exposure can exacerbate asthma (Lipsett et al, 1997)
  - Particle count and not mass best predicts ability to increase sensitization
- Penttinen et al (2001)
  - Peak expiratory flow most closely associated with particle count (0.1 -1 um)
Endotoxin and Asthma

• Significant associations have been observed in the residential environment in both children and adults (Michel et al, 1991, Michel et al, 1996; Rizzo et al, 1997)
Method
Participants

- 115 parents or guardians of asthmatic children under the age of seven residing in Section 8 Housing in Philadelphia
  - Goal to recruit minimum of 200
  - Phone recruitment through public housing roster information
Home visit

- Community Based Participatory Research (CBPR) model
- Surveys
- Visual Inspection
- Particle Sampling
- Dust Endotoxin Sample
Surveys

• Dietary Survey
  – Not analyzed in this portion of the research

• Children’s Health Survey for Asthma (CHSA)
  – American Academy of Pediatrics
  – Validated instrument (Asmussen et al, 1999)
  – Five Domains
    • Physical health (child), Activity (child and family), Emotional Health (child and family)
Visual Inspection

• Modified version of the EPA Asthma Home Environment Checklist (EPA 402-F-03-030) followed as guide
• Intervention delivered during inspection
Particle and Dust Sampling

- **Particle**
  - Fluke 983 Particle Counter (Fluke Corp., Everett, WA)

- **Dust endotoxin**
  - 1 square foot of child sleeping surface
  - 1 minute on a 25 mm endotoxin free polycarbonate filter loaded in three piece styrene cassette and maintained at approximately 4°C until analysis using the Standard LAL Kinetic System (Cambrex Corp., East Rutherford, NJ).
Results
## Sampling Summary

<table>
<thead>
<tr>
<th>Variable</th>
<th>GM (GSD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 um/liter</td>
<td>12137 (7.11)</td>
</tr>
<tr>
<td>0.5 um/liter</td>
<td>1200 (8.56)</td>
</tr>
<tr>
<td>1.0 um/liter</td>
<td>152 (6.58)</td>
</tr>
<tr>
<td>2.0 um/liter</td>
<td>100 (6.00)</td>
</tr>
<tr>
<td>5.0 um/liter</td>
<td>14 (5.92)</td>
</tr>
<tr>
<td>10.0 um/liter</td>
<td>4.3 (6.17)</td>
</tr>
<tr>
<td><strong>EU/mg</strong></td>
<td><strong>1.3 (5.77)</strong></td>
</tr>
</tbody>
</table>
### Activity of Child---Individual Regression Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>-0.326</td>
<td>0.410</td>
</tr>
<tr>
<td>Humidity</td>
<td>0.260</td>
<td>0.116</td>
</tr>
<tr>
<td>ln 0.3 um/liter</td>
<td>-1.448</td>
<td>0.161</td>
</tr>
<tr>
<td>ln 0.5 um/liter</td>
<td>-0.840</td>
<td>0.376</td>
</tr>
<tr>
<td>ln 1.0 um/liter</td>
<td>-0.077</td>
<td>0.940</td>
</tr>
<tr>
<td>ln 2.0 um/liter</td>
<td>-0.324</td>
<td>0.765</td>
</tr>
<tr>
<td>ln 5.0 um/liter</td>
<td>-0.686</td>
<td>0.529</td>
</tr>
<tr>
<td>ln 10.0 um/liter</td>
<td>-1.046</td>
<td>0.326</td>
</tr>
<tr>
<td>ln EU/g</td>
<td>0.803</td>
<td>0.511</td>
</tr>
</tbody>
</table>
Activity of Child---Backwards Regression Final Model

<table>
<thead>
<tr>
<th>Variables in Model</th>
<th>Beta</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity</td>
<td>0.438</td>
<td>0.022</td>
</tr>
<tr>
<td>ln 0.3 um/liter</td>
<td>-5.541</td>
<td>0.006</td>
</tr>
<tr>
<td>ln 1.0 um/liter</td>
<td>4.063</td>
<td>0.037</td>
</tr>
<tr>
<td>ln EU/g</td>
<td>2.119</td>
<td>0.096</td>
</tr>
</tbody>
</table>

Overall p-value: 0.028
<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>-0.094</td>
<td>0.010</td>
</tr>
<tr>
<td>Humidity</td>
<td>-0.040</td>
<td>0.009</td>
</tr>
<tr>
<td>ln 0.3 um/liter</td>
<td>0.223</td>
<td>0.020</td>
</tr>
<tr>
<td>ln 0.5 um/liter</td>
<td>0.198</td>
<td>0.024</td>
</tr>
<tr>
<td>ln 1.0 um/liter</td>
<td>0.186</td>
<td>0.052</td>
</tr>
<tr>
<td>ln 2.0 um/liter</td>
<td>0.175</td>
<td>0.083</td>
</tr>
<tr>
<td>ln 5.0 um/liter</td>
<td>0.195</td>
<td>0.054</td>
</tr>
<tr>
<td>ln 10.0 um/liter</td>
<td>0.193</td>
<td>0.051</td>
</tr>
</tbody>
</table>
## In Endotoxin---Backwards Regression Final Model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beta</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>-0.075</td>
<td>0.044</td>
</tr>
<tr>
<td>Humidity</td>
<td>-0.032</td>
<td>0.042</td>
</tr>
<tr>
<td>ln 0.3 um/liter</td>
<td>0.265</td>
<td>0.004</td>
</tr>
</tbody>
</table>

Overall p-value for model: <0.001
## Particulates and Gas Stoves

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean without gas stove</th>
<th>Mean with gas stove</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln 0.3 um/liter</td>
<td>8.73</td>
<td>9.58</td>
<td>0.085</td>
</tr>
<tr>
<td>ln 0.5 um/liter</td>
<td>6.16</td>
<td>7.33</td>
<td>0.029</td>
</tr>
<tr>
<td>ln 1.0 um/liter</td>
<td>3.88</td>
<td>5.22</td>
<td>0.007</td>
</tr>
<tr>
<td>ln 2.0 um/liter</td>
<td>3.75</td>
<td>4.74</td>
<td>0.035</td>
</tr>
<tr>
<td>ln 5.0 um/liter</td>
<td>1.87</td>
<td>2.74</td>
<td>0.064</td>
</tr>
<tr>
<td>ln10.0 um/liter</td>
<td>0.76</td>
<td>1.56</td>
<td>0.092</td>
</tr>
<tr>
<td>ln EU /g</td>
<td>7.43</td>
<td>7.13</td>
<td>0.587</td>
</tr>
</tbody>
</table>
In 0.3 um particles by location

p-value: 0.010
In 0.5 um particles by location

p-value: 0.017
ln 1.0 um particles by location

p-value: <0.106
ln 2.0 um particles by location

p-value: 0.207
ln 5.0 um particles by location

p-value: 0.063
ln >10 um particles by location

p-value: 0.008
In EU/g by location

p-value: 0.059
ln 0.3 um particles by season

![Box plot showing ln 0.3 particle/liter by season with p-value < 0.001]
ln 0.5 um particles by season

p-value: <0.001
In 1.0 um particles by season

p-value: <0.001
ln 2.0 um particles by season

p-value: <0.001
ln 5.0 um particles by season

p-value: <0.001
ln >10 um particles by season

p-value: <0.001
ln EU/g by season

p-value: 0.105
Asthma Score by Location

p-value: 0.622
Asthma Scores by Season

p-value: 0.679
Conclusions

• Reinforces evidence from other studies that smaller particles are most harmful
• Particulate size fraction may contain information that can help us distinguish between more and less harmful environments
• Endotoxin is most strongly associated with smaller particles but does not correlate with health in this cross-sectional study
• Gas stoves appear to be an important source of indoor particulates
• Location effects may be strongest with the smallest particulates—these are most subject to long range transport (hence outdoor influence) but more detailed analysis needed.
Limitations

- Cross-sectional study may fail to identify effects of previous endotoxin exposures
References