INVESTIGATING THE EFFECTS OF TEMPERATURE INVERSIONS ON AIRWAY DISEASE USING AIRS

Julie Wallace, PhD
• Previous study on bronchitis and proximity to roads
• Separate study on effect of temperature inversions on air pollution
Bronchitis quantitatively defined by proportion of various types of white blood cells

- Sputum samples from patients
- Cell counts
  - Type of airway disease (bronchitis)
  - Severity of airway disease
CELL TYPES

- Neutrophils and Macrophages
- White blood cells
- First line of defense against infection
- Respond quickly

• A few studies suggesting that air pollution caused an increase in neutrophil cells in the airways


TEMPERATURE INVERSIONS

- Influenced by Niagara Escarpment
- Proximity to Great Lakes
HAZE OVER LAKE ERIE

October 7 – 31, 2000

NO₂ (ppb)
Data from GIOVANNI
AIRS Level 3, version 5,
AM/PM temperature profiles
2004-2006
• Neutrophil % increased
• Consistent with other studies
• Largest increases in asthma patients
• Macrophages increased on inversion days
• COPD patients
• Different mechanism in the response to air pollution?
MULTIVARIATE STATISTICAL ANALYSES

• Controlling for
  – Smoking
  – Age
  – Medication
  – Temperature and humidity

• Daytime and night-time inversions
### MULTIVARIATE RESULTS

<table>
<thead>
<tr>
<th></th>
<th>STABLE</th>
<th>EXACERBATED</th>
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<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
<td>Neutrophils (%)</td>
<td>Macrophages (%)</td>
</tr>
<tr>
<td><strong>Continuous Independent variables</strong></td>
<td>IQR change in percent neutrophil (95%CI)</td>
<td>IQR change in percent macrophage (95%CI)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>21.1(16.8,25.5)</td>
<td>-1.6(-2.2,-1.2)</td>
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<tr>
<td>Temperature °C</td>
<td>-0.9(-5.3,3.5)</td>
<td>-1.2(-1.6,1.1)</td>
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<tr>
<td>Relative humidity %</td>
<td>-2.3(-6.4,1.8)</td>
<td>-1.2(-1.5,1.2)</td>
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<td>Inhaled corticosteroids (µg/day)</td>
<td>1.0(-2.0,4.0)</td>
<td>0(0,0)</td>
</tr>
<tr>
<td><strong>Categorical Independent Variables</strong></td>
<td>Change in percent neutrophil (95%CI)</td>
<td>Change in percent macrophage (95%CI)</td>
</tr>
<tr>
<td>Smoker versus non-smoker</td>
<td>-1.0(-7.0,4.9)</td>
<td>1.7(1.1,2.7)</td>
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<tr>
<td>Same day inversion versus normal day (AIRS)</td>
<td>12.6 (3.9,21.4)</td>
<td>2.5 (1.3,4.8)</td>
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CONCLUSIONS

• Cellular response to temperature inversions identified
  – Increased air pollution
  – Increased allergens
  – Combination

• Mechanism may be different for patients who are stable and exacerbated

• Response occurs in short-term (within hours)

• Interesting – the associations of spatial scales from regional/global to cellular
Current environmental conditions not previously considered

Could not always explain increases in cell counts in stable patients

Re-think patient diagnoses

Occurrence of temperature inversions should be added to air quality forecasts and Air Quality Health Indices