Air Pollution and Respiratory Infections during Early Childhood: An Analysis of Ten European Birth Cohorts within the ESCAPE Project

Elaina MacIntyre

July 16, 2013
Background

• European Union Thematic Strategy on Air Pollution

• European Study of Cohorts for Air Pollution Effects (ESCAPE)

• European Community's Seventh Framework Programme
  • 2008-2012: €5.8M

• Objectives:
  (1) Develop methodology for assessing long-term population exposure to air pollution
  (2) Conduct epidemiological analyses to estimate the risk of adverse health outcomes associated with current levels of air pollution
**Phase 1**

Individual Estimates of Air Pollution Exposure

**Previously Established Birth & Adult Cohorts**

**Phase 2**

- Birth Outcomes
- Childhood Respiratory Disease
- Childhood Cognition
- Adult Respiratory Disease
- Cardiovascular Disease
- Cancer Incidence
- Natural Cause Mortality

- Infections
- Sensitization
- Asthma
- Lung Function
Particulate Matter + Nitrogen Oxides

Measurement of nitrogen oxides

Measurement of particulate
<table>
<thead>
<tr>
<th>Study</th>
<th>Location</th>
<th>Design</th>
<th>Birth</th>
<th>Sample</th>
<th>Exposure</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAMSE</td>
<td>Sweden</td>
<td>Population Based Birth Cohort</td>
<td>1994-6</td>
<td>3,821</td>
<td>NO\textsubscript{x} + PM</td>
<td>Pneumonia Otitis Media Croup</td>
</tr>
<tr>
<td>GASPII</td>
<td>Italy</td>
<td>Population Based Birth Cohort</td>
<td>2003-4</td>
<td>678</td>
<td>NO\textsubscript{x} + PM</td>
<td>Pneumonia Otitis Media</td>
</tr>
<tr>
<td>GINI</td>
<td>Germany</td>
<td>Population Based Birth Cohort</td>
<td>1995-8</td>
<td>5,991</td>
<td>NO\textsubscript{x} + PM</td>
<td>Pneumonia Croup</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Population Based Birth Cohort (with formula intervention)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LISA</td>
<td>Germany</td>
<td>Population Based Birth Cohort</td>
<td>1997-9</td>
<td>1,815</td>
<td>NO\textsubscript{x} + PM</td>
<td>Pneumonia Otitis Media</td>
</tr>
<tr>
<td>INMA</td>
<td>Spain</td>
<td>Combined Population Based Birth Cohorts</td>
<td>1997-2008</td>
<td>1,758</td>
<td>NO\textsubscript{x} + PM (1/4)</td>
<td>Pneumonia Otitis Media</td>
</tr>
<tr>
<td>MAAS</td>
<td>UK</td>
<td>Population Based Birth Cohort</td>
<td>1995-7</td>
<td>695</td>
<td>NO\textsubscript{x} + PM</td>
<td>Pneumonia Croup</td>
</tr>
<tr>
<td>PIAMA</td>
<td>The Netherlands</td>
<td>Population Based Birth Cohort</td>
<td>1996-7</td>
<td>3,475</td>
<td>NO\textsubscript{x} + PM</td>
<td>Pneumonia Otitis Media</td>
</tr>
</tbody>
</table>
Rationale for Selected Outcomes

- Pneumonia (2-8% by cohort)
  - Lower respiratory tract
  - Consistent associations with high indoor air pollution

- Otitis Media (22-50% by cohort)
  - Upper respiratory tract
  - Some evidence for association with traffic-related air pollution

- Croup (10-13% by cohort)
  - Upper respiratory tract
  - Equivocal evidence from ecological examinations and point source proximity
Methods: Individual & Combined Cohort Analysis

I. Logistic Regression

• Annual average exposures assigned to address (birth - 1 year):
  • NO₂, NOₓ, PM₂.₅ Absorbance, PM₂.₅, PM₁₀, Coarse PM, Traffic Proximity

• Cumulative incidence (birth - 2/3 years):
  • Pneumonia, Otitis Media, Croup

• Adjusting for:
  
  Gender  | Daycare  | Gas stove  | Parental SES
  Breastfeeding  | ETS (mat/home)  | Birth season  | Municipality
  Siblings  | Mold/dampness  | Parental atopy  | Intervention

II. Random Effect Meta-analysis
Results: NO$_2$ & Pneumonia

Adjusted Odds Ratios and 95% Confidence Intervals

<table>
<thead>
<tr>
<th>Study</th>
<th>Pop</th>
<th>Wgt</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAMSE</td>
<td>3694</td>
<td>14.2</td>
</tr>
<tr>
<td>GASPII</td>
<td>678</td>
<td>9.1</td>
</tr>
<tr>
<td>GINI/LISA South</td>
<td>3321</td>
<td>19.4</td>
</tr>
<tr>
<td>GINI/LISA North</td>
<td>2460</td>
<td>15.2</td>
</tr>
<tr>
<td>INMA Asturias</td>
<td>360</td>
<td>6.7</td>
</tr>
<tr>
<td>INMA Gipuzkoa</td>
<td>437</td>
<td>1.9</td>
</tr>
<tr>
<td>INMA Sabadell</td>
<td>402</td>
<td>4.2</td>
</tr>
<tr>
<td>INMA Valencia</td>
<td>559</td>
<td>9.4</td>
</tr>
<tr>
<td>MAAS</td>
<td>694</td>
<td>0.6</td>
</tr>
<tr>
<td>PIAMA</td>
<td>3454</td>
<td>16.2</td>
</tr>
</tbody>
</table>

Combined Random: 16059

Combined Fixed: 16059

1.30(1.03-1.65)

1.29(1.13-1.48)
Results: $\text{NO}_2$ & Otitis Media

Adjusted Odds Ratios and 95% Confidence Intervals

- BAMSE 3694 8.2
- GASPiI 678 11.7
- LISA South 1241 9.7
- LISA North 269 14.2
- INMA Asturias 360 10.1
- INMA Gipuzkoa 437 0.4
- INMA Sabadell 402 9.4
- INMA Valencia 559 1.9
- PIAMA 3454 34.3

Combined Random 11094

Combined Fixed 11094

1.09 (1.02-1.16)

1.09 (1.02-1.16)
Results: Summary of Combined Estimates

<table>
<thead>
<tr>
<th></th>
<th>Pneumonia</th>
<th>Otitis Media</th>
<th>Croup</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO$_2$</td>
<td>1.30 *</td>
<td>1.09 *</td>
<td>0.96</td>
</tr>
<tr>
<td>NO$_x$</td>
<td>1.26 *</td>
<td>1.05</td>
<td>0.99</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>2.58</td>
<td>1.06</td>
<td>0.90</td>
</tr>
<tr>
<td>PM$_{2.5}$ absorbance</td>
<td>1.99 *</td>
<td>1.08</td>
<td>1.03</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>1.76 *</td>
<td>0.98</td>
<td>0.92</td>
</tr>
<tr>
<td>Coarse PM</td>
<td>1.24 *</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>Nearest street</td>
<td>1.09 *</td>
<td>0.98</td>
<td>0.99</td>
</tr>
<tr>
<td>Closest major street</td>
<td>1.21 *</td>
<td>0.99</td>
<td>0.98</td>
</tr>
</tbody>
</table>

* Statistically significant combined estimate (p-value < 0.05). Increments reported: 10 µg/m³ for NO$_2$, 20 µg/m³ for NO$_x$, 5 µg/m³ for PM$_{2.5}$, 1 unit for PM$_{2.5}$ absorbance, 10 µg/m³ for PM$_{10}$, 5 µg/m³ for coarse PM, 5,000 veh·day·1·m for traffic intensity on the nearest street; and 4,000,000 veh·day·1·m for traffic load on major roads within a 100 m buffer.

www.publichealthonontario.ca
Implications

- Reassessment of European Union ambient guidelines in 2013
- 3.6M life-years lost / year
- Detailed examination within Europe
- Focus on spatial contrasts
  - Within-city/area
- Independent examination of fine and coarse PM
Participating Centers

- U Utrecht
- IMM KI Stockholm
- Helmholtz Munich
- U Duesseldorf
- U Manchester
- CREAL Barcelona
- ASL Roma
- U Athens
- U Heraklion
- U Basel
- IC London
- U Duisburg-Essen
- U Ulm
- DCS Copenhagen
- FHI Oslo
- U Umea
- INVS St Maurice
- INSERM Villejeuf
- THL Kuopio
- VMU Kaunas
- NIEH Budapest
- IOM Edinburgh
- RIVM Bilthoven
- MRC London
- NTU Taipei
- HHF Athens
Additional Information

- This work is currently under review
  - Subsequent work is currently being prepared for publication (Fuertes, Elaine)

- Study website: http://www.escapeproject.eu/

- Research articles: