Effects of fine and ultrafine particles on the heart

Annette Peters, PD, Dr. rer. hum. biol., MSc, GSF-National Research Center for Environment and Health
Outline

- What is a heart attack?
- Are times spent in traffic a risk factor for heart attacks?
- Examining the plausibility
Outline

- What is a heart attack?
- Are times spent in traffic a risk factor for heart attacks?
- Examining the plausibility
Heart attack: Occlusion of the Coronary Arteries

Healthy heart

Occlusion

Re-Perfusion
## Risk Factors for a Heart Attack

<table>
<thead>
<tr>
<th>Chronic Risk Factors</th>
<th>Acute Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>= increase your baseline risk</td>
<td>= increase your risk transiently</td>
</tr>
<tr>
<td></td>
<td>= Triggers</td>
</tr>
<tr>
<td>✗ High Cholesterol, Hypertension, Smoking, Sedentary Life-Style, Stress</td>
<td>✗ Strenuous activities, extreme anger, air pollution, marihuana, cocaine</td>
</tr>
<tr>
<td>✗ Age, Gender, Diabetes, Genetic Predisposition</td>
<td></td>
</tr>
</tbody>
</table>
Outline

- What is a heart attack?
- Are times spent in traffic a risk factor for heart attacks?
- Examining the plausibility
Study on Heart Attacks

- A study of nonfatal heart attacks age 25 to 74 years based on the Coronary Event Registry Augsburg

- Bedside interview of all cases between 1999 and mid 2001

- Detailed recollection of activities during the 4 days before the event

Peters et al. 2004 NEJM
Peters et al. 2005 HEI Report
Times Spent in Traffic before Heart Attack (N=691)

Peters et al. 2004 NEJM
Peters et al. 2005 HEI Report
Times Spent in Traffic in the Hours before Heart Attack (N=691)

Peters et al. 2004 NEJM
Peters et al. 2005 HEI Report
### Times Spent in Traffic and Heart Attacks one hour later

<table>
<thead>
<tr>
<th></th>
<th>Traffic</th>
<th>Cars</th>
<th>Public Transport</th>
<th>Bicycles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Odds Ratio</strong></td>
<td>2.9</td>
<td>2.6</td>
<td>3.1</td>
<td>3.9</td>
</tr>
<tr>
<td><strong>95% Confidence Interval</strong></td>
<td>2.2 – 3.8</td>
<td>1.9 – 3.6</td>
<td>1.4 – 6.8</td>
<td>2.1 – 7.2</td>
</tr>
</tbody>
</table>

Peters et al. 2004 NEJM
Peters et al. 2005 HEI Report
## Adjustment for Individual Activities: Strenuous Exercise, Outdoors and Getting Up

<table>
<thead>
<tr>
<th></th>
<th>Traffic</th>
<th></th>
<th>Bicycles</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>adjusted</td>
<td></td>
<td>adjusted</td>
<td></td>
</tr>
<tr>
<td><strong>Odds Ratio</strong></td>
<td>2.9</td>
<td>2.7</td>
<td>3.9</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>95% Confidence Interval</strong></td>
<td>2.2 – 3.8</td>
<td>2.1 – 3.6</td>
<td>2.1 – 7.2</td>
<td>0.9 – 3.6</td>
</tr>
</tbody>
</table>

Peters et al. 2004 NEJM
Peters et al. 2005 HEI Report
Outline

- What is a heart attack?
- Are times spent in traffic a risk factor for heart attacks?
- Examining the plausibility
Exertion and the Risk of a Heart Attack had Effects Similar to Other Studies

<table>
<thead>
<tr>
<th></th>
<th>Mittleman et al. 1993</th>
<th>Augsburg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odds Ratio</td>
<td>5.9</td>
<td>6.4</td>
</tr>
<tr>
<td>95% Confidence Interval</td>
<td>4.6 – 7.7</td>
<td>3.9 – 10.5</td>
</tr>
</tbody>
</table>

Mittleman et al. 1993 NEJM
Peters et al. 2004 NEJM
What does a diary tell about traffic related exposures?

- No measured exposure to traffic related particles or traffic related stress
- No information on driving conditions, roads traveled or traffic flow
- Individual level information on a surrogate of exposure for potentially susceptible individuals in a critical time window
PM$_{10}$ and Heart Attacks

- More than 300,000 cases of hospital admissions due to heart attacks
- 21 US American cities
- Data between 1986 to 1999
- Age 65 and older

<table>
<thead>
<tr>
<th></th>
<th>10 µg/m$^3$ PM$_{10}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Ratio</td>
<td>0.6%</td>
</tr>
<tr>
<td>95% Confidence Interval</td>
<td>0.3% – 1.0%</td>
</tr>
</tbody>
</table>

Zanobetti & Schwartz 2005 EHP
Lung Inflammation
Allergy - Sensitization
Chronic lung diseases

Systemic effects mediated by
Autonomic nervous system
Translocation of particles
Inflammatory mediators

Cardiovascular Effects of Fine and Ultrafine Particles

Heart Attack
Sudden cardiac death
Summary

- Ambient particulate matter has been associated with hospital admissions for heart attacks
- Time spent in traffic may be a trigger for heart attacks
- There might be effects of fine and ultrafine particles within hours based on the currently proposed mechanisms
Outlook

- Traffic as a source of stress and particle exposures needs to be investigated

- Different particle properties such as size and chemical composition are currently being investigated

- Different pathophysiological pathways are currently being investigated which may induce health effects within hours, days and years
Thank You to

- Health Effects Institute
  www.healtheffects.org
- Rochester Particle Center
- GSF-KORA Coronary Event Registry
- GSF-Institute of Epidemiology
  St. von Klot, J. Cyrys, M. Heier, I. Trentinaglia, H.E. Wichmann
Questions?