Cardiovascular Emergency Calls Associated to Urban Submicron Aerosol Fractions

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Introduction: It is well known that high concentrations of airborne particles are associated with the development of various environment related diseases and the exacerbation of various diseases. Since middle of the nineties epidemiologists found more and more indications that in addition to respiratory illnesses cardiovascular illnesses seem to be associated to airborne particulates. Recently, ultrafine particles have come under special scientific scrutiny. Usually, these particles do not contribute significantly to the mass concentration PM10 but they dominate particle number concentration. Especially, cardiovascular diseases are under suspicion to be evoked and exacerbated by particles significantly smaller than one micrometer.

This study is primarily aiming at two questions:
One aim is to investigate the influence of “rather low” common urban concentrations on the health state of city dwellers, who are not occupationally exposed.
Secondly, this study is quantifying risk differences for selected cardiovascular diseases associated with different size fractions of submicrometer particles, PM2.5 and PM10.

Material and Methods: The study was carried out in the city of Leipzig. This city is located in the Leipzig basin with no significant elevations in and around the city. Leipzig has approx. 500,000 inhabitants. There is no significant pollution by industry. In the City of Leipzig urban traffic is a very important source of airborne particles.

Aerosol measurements were carried out at the Leibniz Institute for Tropospheric Research using TDMPS (twin differential mobility sizer system) working detecting particles with diameters from 3 to 800 nm. The measuring site can be regarded as urban background. Additionally, PM10 and PM2.5 data of public authorities were used for comparison of the health effects of these coarser particles with the effects of the smaller ones.

Cardiovascular emergency calls were selected from the total number of emergency calls for a time period of 12 month within the City of Leipzig.

Therefore, there is no bias produced by the selection of areas within the city.

Results: Table 1 lists the urban particle concentrations of different size fractions found during the measuring period.

<table>
<thead>
<tr>
<th>Size Fractions</th>
<th>Mean</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;100 nm; PM µg/m³)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dp&lt;100</td>
<td>12094</td>
<td>10893</td>
<td>1487</td>
<td>34650</td>
</tr>
<tr>
<td>100&lt;Dp&lt;500</td>
<td>1919</td>
<td>1723</td>
<td>334</td>
<td>18668</td>
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<tr>
<td>Dp&gt;500</td>
<td>28.54</td>
<td>17.91</td>
<td>2.107</td>
<td>280</td>
</tr>
<tr>
<td>Dp&lt;800</td>
<td>14043</td>
<td>13111</td>
<td>2450</td>
<td>35338</td>
</tr>
<tr>
<td>PM10</td>
<td>32.48</td>
<td>28.56</td>
<td>6.829</td>
<td>109.7</td>
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<tr>
<td>PM2.5</td>
<td>20.61</td>
<td>18.18</td>
<td>1.375</td>
<td>84.06</td>
</tr>
</tbody>
</table>

Table 1. Statistics of daily averages of particle number concentrations during the measuring period.

In total 5326 cardiovascular emergency calls were used for epidemiologic analysis. Generally, there is no significant difference in incidence between the weekdays and weekends. There are 22.74% and 22.44 % of cardiovascular emergency calls, respectively.

We found:
• a significant positive correlation between the risk for cardiovascular emergency calls and the particle number concentrations,
• a time lag of 1 to 8 days for the health effect of the particles,
• differences in effect for different particle size fractions,
• differences in effect on different cardiovascular diseases.

Significant effects could be found despite of the great inner urban differences in the concentrations of some particle fractions (Tuch et al. 2006).