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Short-term effects of exposure to ambient fine particulate matter on out-of-hospital cardiac arrest: a nationwide case-crossover study in Japan

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Topic(s):
Environmental Aspects of Heart Disease

Introduction: The cardiovascular health consequences of ambient air pollution generally equal or exceed those due to pulmonary diseases and cancers. Particulate matter less than 2.5µm in aerodynamic diameter (PM2.5) has become a major focus of research on the short-term exposure to air pollution and cardiovascular disease. However, the evidence regarding the association between several air pollutants and out-of-hospital cardiac arrest (OHCA), has been inconsistent, which could be due to limited sample sizes (∼11,000). Thus, a larger study may assist in characterising possible associations.

Purpose: This study aimed to identify the associations between exposure to ambient air pollution and the incidence of OHCA in Japan.

Methods: A case-crossover design was used to determine the odds ratio (OR) of OHCA across Japan with daily exposure of PM2.5, carbon monoxide (CO), photochemical oxidants (Ox), and sulfur dioxide (SO2) on the day of the arrest or 1–3 days before it (lag 0–3). OHCA cases were identified through the All-Japan Utstein registry of the Fire and Disaster Management Agency from January 1, 2014 to December 31, 2015. All cause OHCA cases were investigated by conditional logistic regression adjusted for daily temperature and relative humidity.

Results: A total of 249,372 OHCA cases included during study period. Each 10 μg/m³ increase in daily PM2.5 exposure over 4 days was associated with all cause OHCA risk (lag 0: OR 1.017, 95% confidence interval (CI) 1.010, 1.024; lag 1: OR 1.015, 95% CI 1.008, 1.022; lag 2: OR 1.018, 95% CI 1.011, 1.025; lag 3: OR 1.021, 95% CI 1.014, 1.028; lag 0–1: OR 1.022, 95% CI 1.014, 1.030). CO, Ox and SO2 also showed significant associations with OHCA. In the multi-pollutant model, the effects of PM2.5 remained independent of CO, Ox and SO2 (Table).

Conclusion: Short-term exposure to PM2.5 was independently associated with an increased risk of OHCA.
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Conclusion:
Short-term exposure to PM2.5 was independently associated with an increased risk of OHCA.

<table>
<thead>
<tr>
<th></th>
<th>Lag0</th>
<th>Lag1</th>
<th>Lag2</th>
<th>Lag3</th>
<th>Lag0-1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unadjusted</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PM2.5</td>
<td>1.009 (1, 1.019) *</td>
<td>1.002 (0.993, 1.011)</td>
<td>1.011 (1.002, 1.021) *</td>
<td>1.014 (1.004, 1.023) **</td>
<td>1.007 (0.996, 1.018)</td>
</tr>
<tr>
<td>CO</td>
<td>1.024 (0.950, 1.103)</td>
<td>1.04 (0.965, 1.12)</td>
<td>1.007 (0.934, 1.086)</td>
<td>1.0002 (0.927, 1.079)</td>
<td>1.055 (0.968, 1.15)</td>
</tr>
<tr>
<td>Ox</td>
<td>1.006 (0.999, 1.013)</td>
<td>1.005 (0.998, 1.012)</td>
<td>1.001 (0.994, 1.008)</td>
<td>0.996 (0.989, 1.003)</td>
<td>1.005 (0.997, 1.013)</td>
</tr>
<tr>
<td>SO2</td>
<td>0.973 (0.919, 1.03)</td>
<td>1.015 (0.964, 1.069)</td>
<td>0.983 (0.932, 1.038)</td>
<td>1.005 (0.954, 1.059)</td>
<td>0.99 (0.923, 1.062)</td>
</tr>
<tr>
<td><strong>Adjusted for temperature and humidity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM2.5</td>
<td>1.016 (1.006, 1.026) **</td>
<td>1.011 (1.002, 1.021) *</td>
<td>1.019 (1.009, 1.029) **</td>
<td>1.022 (1.012, 1.032) **</td>
<td>1.019 (1.008, 1.031) **</td>
</tr>
<tr>
<td>CO</td>
<td>1.023 (0.947, 1.104)</td>
<td>1.014 (0.94, 1.095)</td>
<td>0.987 (0.914, 1.066)</td>
<td>0.981 (0.908, 1.06)</td>
<td>1.021 (0.934, 1.117)</td>
</tr>
<tr>
<td>Ox</td>
<td>1.003 (0.996, 1.01)</td>
<td>1.007 (0.999, 1.014)</td>
<td>1.003 (0.993, 1.008)</td>
<td>0.995 (0.988, 1.003)</td>
<td>1.005 (0.996, 1.013)</td>
</tr>
<tr>
<td>SO2</td>
<td>0.967 (0.912, 1.026)</td>
<td>1.033 (0.982, 1.088)</td>
<td>0.997 (0.944, 1.052)</td>
<td>1.024 (0.972, 1.079)</td>
<td>1.0007 (0.932, 1.074)</td>
</tr>
</tbody>
</table>

Per 10-unit change. *p<0.05. **p<0.01.