• Exposure to ambient particulate matter (PM) air pollution has been associated with increased blood pressure (BP) in some but not all studies.

• We investigated the association between short-term average levels of PM$_{2.5}$ and black carbon (BC) and BP in the Framingham Heart Study (FHS) Offspring cohort, hypothesizing that higher short-term exposure would be associated with higher BP.

**METHODS**

**Study Design**
- Repeated measures prospective cohort study

**Study Population**
- Framingham Heart Study Offspring Cohort at Exams 7 (9/1998-10/2001, n=1,966) and 8 (03/2005-1/2008, n=1,604)
- Excluded subjects living more than 40 km from pollution monitoring site

**Pollution Data**
- Hourly measures PM$_{2.5}$ and BC were obtained from the Harvard SuperSite in Boston, Massachusetts and averaged to create daily exposure values

**Blood Pressure Data**
- Systolic (SBP) and diastolic (DBP) BP were measured by two physicians and the results averaged at each FHS exam visit
- Extensive clinical and demographic information was obtained at the FHS visits

**Statistical Analysis**
- Separate mixed effects models were constructed for 1, 2, 3, 5, 7, 14, 21, and 28-day moving averages (MAs) of the pollutant concentrations and BP outcomes
  - Mixed effects regression controls for between-person differences by including random subject-specific intercepts and thus isolating the within-person estimates of association
  - Primary analyses: PM$_{2.5}$ and BC concentrations were modeled as continuous linear functions and adjusted for age, sex, body mass index, use of lipid-lowering and antihypertensive medications, diabetes, prevalent cardiovascular disease, smoking, season, apparent temperature, and date
  - We controlled for time by putting in a term for date and date squared.
  - We modeled seasonal trends as sin(2*π*day of study/365.24) + cos(2*π*day of study/365.24)
  - As apparent temperature is highly correlated with the seasonal terms, we first regressed the apparent temperature against the cosine/sine terms and then included the residuals and squared residuals in our model.
  - Secondary analyses: We looked specifically within vulnerable groups including subjects with diabetes and women.
  - All results are presented as a change in blood pressure associated with a 1 µg/m$^3$ increase in pollutant concentration, with 95% confidence intervals (CI)

**RESULTS**

**Table 1: Patient Characteristics**

<table>
<thead>
<tr>
<th></th>
<th>Exam 7 (n=1,966)</th>
<th>Exam 8 (n=1,607)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y (SD)</td>
<td>61.5 (9.5)</td>
<td>67.5 (9.3)</td>
</tr>
<tr>
<td>Female (%)</td>
<td>1060 (54)</td>
<td>887 (55)</td>
</tr>
<tr>
<td>BMI, kg/m$^2$ (SD)</td>
<td>28.3 (5.3)</td>
<td>28.5 (5.4)</td>
</tr>
<tr>
<td>SBP, mmHg (SD)</td>
<td>127.5 (19.0)</td>
<td>129.5 (17.8)</td>
</tr>
<tr>
<td>DBP, mmHg (SD)</td>
<td>73.8 (9.8)</td>
<td>73.2 (10.1)</td>
</tr>
<tr>
<td>Use of Lipid-Lowering Medications (%)</td>
<td>444 (23)</td>
<td>809 (50)</td>
</tr>
<tr>
<td>Use of Anti-Hypertensive Medications (%)</td>
<td>718 (37)</td>
<td>958 (60)</td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>215 (11)</td>
<td>242 (16)</td>
</tr>
<tr>
<td>Cardiovascular Disease (%)</td>
<td>280 (14)</td>
<td>297 (19)</td>
</tr>
<tr>
<td>Current Smoking (%)</td>
<td>278 (14)</td>
<td>148 (9)</td>
</tr>
</tbody>
</table>

**Figure 1: Association between 1 µg/m$^3$ increase in Pollutants and BPs At Different MAs**

**CONCLUSIONS**

• In this preliminary analysis of a cohort of largely suburban community-dwelling middle-aged-to-elderly white American adults, there was no apparent association between short-term exposure to PM$_{2.5}$ or BC and BP.
• Different methods for controlling for seasonality and secular trends did not alter the results.
• Results did not differ materially in subgroup analyses of diabetics and women.
• There may truly be no relationship between blood pressure and short-term exposure to air pollution, or there may be residual confounding.
• Future analyses will incorporate additional FHS exams and alternative exposure assessments based on satellite data and land-use regression, as well as assess the association between chronic exposure to traffic related pollutants and BP.
• Given the overall deleterious effects of air pollution on cardiovascular health, these results should not be used to support relaxation of current air quality standards.

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