Persistent Organic Pollutants and Mortality in the United States
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BACKGROUND
- Persistent organic pollutants (POPs) are environmentally and biologically persistent chemicals that include polybrominated diphenyl ethers (PBDEs), per- and polyfluoroalkyl Substances (PFASs), polychlorinated biphenyls (PCBs), and organochlorine (OC) pesticides
- Currently, there is limited data on the association between exposure to POPs and the risk of mortality in the general US population

OBJECTIVE: To determine if higher exposure to POPs is associated with greater risk of all-cause, cancer, heart/cerebrovascular disease, or other-cause mortality in persons aged 60 years and older

METHODS
SAMPLE
- 1999-2006 National Health and Nutrition Examination Survey (NHANES) participants aged 60 years and older with necessary data

EXPOSURE
- Exposures to POPs (PBDEs, PFASs, PCBs, OC pesticides) were estimated using biomarkers measured in serum
- PBDE, PFAS, and OC Pesticide analytes were analyzed if they were detected in greater than 90% of the subpopulation
- Summary measures were created for PBDE and PCB analytes
  - PBDEs: sums of all PBDEs and those detected in greater than 90%
  - PCBs: sums of all dioxin-like, all non-dioxin-like, toxic equivalency factor (TEF) dioxin-like, and the corresponding sums of those detected in greater than 90%
- If analyte concentration measures were below the limit of detection (LOD), we substituted the value of LOD/√2

OUTCOME
- We used the National Center for Health Statistics 2011 Public-use Linked Mortality Files to determine mortality status through December 31, 2011, including:
  - All-cause mortality
  - Cancer mortality
  - Heart disease and cerebrovascular disease (CBVD) mortality
  - Other-cause mortality

STATISTICAL METHOD
- Cox proportional hazard models and 95% confidence intervals

RESULTS

Table 1. Characteristics and outcome of eligible NHANES adults, by POP analyte group

<table>
<thead>
<tr>
<th>POP analyte group</th>
<th>NHANES survey years</th>
<th>Age (yrs), median</th>
<th>Follow-Up Time (yrs), median</th>
<th>Mortality Status, % deceased</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBDEs (n=483)</td>
<td>2003-2004</td>
<td>70.4</td>
<td>6.4</td>
<td>All-cause: 25.7%</td>
</tr>
<tr>
<td>PFASs (n=1043)</td>
<td>2003-2006</td>
<td>71.0</td>
<td>5.5</td>
<td>Cancer: 6.7%</td>
</tr>
<tr>
<td>PCBs (n=461)</td>
<td>2003-2004</td>
<td>70.2</td>
<td>7.4</td>
<td>Other-cause: 11.9%</td>
</tr>
<tr>
<td>OC Pesticides (n=1428)</td>
<td>1999-2004</td>
<td>70.5</td>
<td>8.7</td>
<td></td>
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</tbody>
</table>

Figure 1. Associations between a one standard deviation unit increase in serum PBDE, PFAS, and PCB measures and all-cause mortality

Figure 2. Associations between a one standard deviation unit increase in serum OC pesticide measures and all-cause and cause-specific mortality

CONCLUSION
- Overall, exposure to PBDEs, PFASs, or PCBs, is not associated with all-cause or cause-specific mortality in adults 60 years or older in the US
- Higher exposure to one OC pesticide, β-hexachlorocyclohexane, is associated with increased all-cause mortality adults 60 year or older in the US
- Higher exposure to four OC pesticides is associated with increased non-cancer, non-CVD mortality in adults 60 years or older in the US

*Adjusted for age, race/ethnicity, smoking status, education, and gender; naturally unchanged with additional adjustment for alcohol consumption, BMI, and poverty income ratio.