Per- and Polyfluoroalkyl Substances and Bone Mineral Density in Mid-childhood

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Background

Identifying factors that impair bone accrual during childhood is a critical step toward osteoporosis prevention.

Higher exposure to PFASs was associated with lower aBMD Z-score.

Methods

Examine the associations of plasma PFAS concentrations with aBMD Z-score in mid-childhood (mean 7.9 years).

Study population (Project Viva)

Examine the associations of plasma PFAS concentrations with aBMD Z-score in mid-childhood (mean 7.9 years).

Boston-area pregnant women enrolled 1999-2002 into the prospective Project Viva birth cohort study.

Enrolled: 2,128 mother-infant pairs

Mid-childhood follow-up: 1,116 children

Plasma PFAS measured: 653 children

aBMD measured: 576 children

Table 1. Participant characteristics overall and by PFAS plasma concentration quartiles

<table>
<thead>
<tr>
<th>Quartiles of aBMD Z-score</th>
<th>Overall</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=576</td>
<td>144</td>
<td>145</td>
<td>145</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>aBMD Z-score</td>
<td>-0.34</td>
<td>-2.5</td>
<td>-2.2</td>
<td>-2.0</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

Statistical analyses:

- Used linear regression to examine associations of each PFAS with aBMD Z-score separately in single-PFAS models, and mutually adjusted with other PFASs in a multi-PFAS model.

Table 2. Plasma PFAS concentration distributions and correlations

<table>
<thead>
<tr>
<th>Plasma PFAS concentrations (ng/mL)</th>
<th>PFOA</th>
<th>PFOS</th>
<th>PFHxS</th>
<th>MeFOSAA</th>
<th>PFNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median (IQR)</td>
<td>4.4 (3.2)</td>
<td>6.4 (5.6)</td>
<td>0.3 (0.9)</td>
<td>1.9 (3.2)</td>
<td>0.3 (0.5)</td>
</tr>
<tr>
<td>5th percentile</td>
<td>1.9</td>
<td>2.1</td>
<td>&lt; LOD</td>
<td>0.6</td>
<td>&lt; LOD</td>
</tr>
<tr>
<td>95th percentile</td>
<td>9.8</td>
<td>18.7</td>
<td>0.7</td>
<td>14.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Detection frequency (%)</td>
<td>99.5</td>
<td>88.4</td>
<td>99.5</td>
<td>65.6</td>
<td>99.5</td>
</tr>
</tbody>
</table>

Results

Strengths and Limitations

Strengths

- Among the first studies to evaluate role of toxics on bone health in childhood.

- PFAS concentrations typical for US population during peak production.

- Used WGS regression to assess exposure to PFAS mixture.

Limitations

- High SES cohort limits generalizability.

- Cross sectional analysis, so unable to assess mediation by BMI or pubertal status.

Conclusions

- Higher exposure to PFASs was associated with lower aBMD Z-scores.

- Lower exposures to environmental toxics such as PFASs may improve childhood bone accrual and optimize lifelong skeletal health.

Acknowledgements

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References