Consumer Product Use and Suspect Screening of Environmental Phenols and Phthalate Metabolites in Maternal Serum

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Introduction
- Consumer products are important sources of exposure to endocrine disrupting chemicals (EDCs), such as phthalates and environmental phenols (including parabens, triclosan, and bisphenol-A).
- Due to non-equal health risks, it is important to monitor the various EDCs among pregnant women and identify sources of exposure.
- We developed a suspect screening method to screen for environmental phenols and phthalate metabolites using high resolution mass spectrometry.

Aims: 1) profile the pattern of suspect phenols and phthalate metabolites detected in serum samples from a racially and economically diverse cohort of pregnant women, and consumer product use including use of personal care products (PCPs) or household cleaning products (HCPs); 2) assess the relationship between suspect detection and PCPs or HCPs.

Methods
Study sample
Seventy-five serum samples were collected at delivery from pregnant women receiving care at Zuckenberg San Francisco General Hospital or UCSF Medical Center.

Consumer product use information and demographic variables including age, race/ethnicity, educational attainment, annual household income were collected using structured questionnaire during face-to-face interview.

Chemical analysis and data processing (Fig 1)
We used liquid chromatography-quadrupole time-of-flight mass spectrometry (LC-QTOF/MS) with Agilent QTOF/MS 6550 instrument. We used Agilent MassHunter Qualitative Analysis software Find By Formula algorithm to generate a list of exact mass matches – compounds whose exact masses (acquired in the LC-QTOF/MS analysis) matched the exact masses of chemicals in the suspect database. Additional data processing steps for all accurate mass matches included visual inspections/reviews of the total ion chromatogram peaks and differentiation of isomers based on LC-QTOF/MS retention time. When a mass spectral feature matches to a chemical in our suspect database, we call this feature a “suspect phenol” or a “suspect phthalate metabolite” as they are not confirmed compounds.

Statistical analysis
We used pairwise t-tests to assess the demographic differences in the number of PCPs, HCPs, suspect phenols, or suspect phthalate metabolites. Due to the high dimensionality of the data with relatively small sample size, we used a two-stage approach to assess the relationship between suspect detection and daily use of PCP or HCP: 1) used linear regression with adjustment for race/ethnicity, education, and income groups.

Table 1. Relationship between number of suspects and daily consumer product use (Y/N)

<table>
<thead>
<tr>
<th>Product</th>
<th>N PCP used daily</th>
<th>N HCP used daily</th>
<th>N suspect phenols</th>
<th>N suspect phthalate metabolites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun screen</td>
<td>0.78 (p = 0.56)</td>
<td>0.89 (p = 0.37)</td>
<td>0.89 (p = 0.49)</td>
<td>0.99 (p = 0.99)</td>
</tr>
<tr>
<td>Make up</td>
<td>0.58 (p = 0.65)</td>
<td>0.91 (p = 0.89)</td>
<td>0.91 (p = 0.89)</td>
<td>0.99 (p = 0.99)</td>
</tr>
<tr>
<td>Lotion</td>
<td>3.44 (p = 0.91)</td>
<td>0.91 (p = 0.89)</td>
<td>0.91 (p = 0.89)</td>
<td>0.99 (p = 0.99)</td>
</tr>
<tr>
<td>Lip balm/lotions</td>
<td>0.64 (p = 0.58)</td>
<td>0.91 (p = 0.89)</td>
<td>0.91 (p = 0.89)</td>
<td>0.99 (p = 0.99)</td>
</tr>
<tr>
<td>Heat gels/pads</td>
<td>0.25 (p = 0.05)</td>
<td>0.91 (p = 0.89)</td>
<td>0.91 (p = 0.89)</td>
<td>0.99 (p = 0.99)</td>
</tr>
<tr>
<td>Deodorant</td>
<td>0.07 (p = 0.97)</td>
<td>1.00 (p = 1.00)</td>
<td>1.00 (p = 1.00)</td>
<td>1.00 (p = 1.00)</td>
</tr>
<tr>
<td>HCP daily use</td>
<td>3.43 (p = 0.02)</td>
<td>0.13 (p = 0.23)</td>
<td>0.23 (p = 0.97)</td>
<td>0.97 (p = 0.97)</td>
</tr>
</tbody>
</table>

The number of PCP or HCP used daily was not correlated with the overall number of suspect phenols or suspect phthalate metabolites detected.

Stage 1 results:
- The detection (Y/N) of three suspect phenols (out of 14 suspects tested) were associated with daily use of lotion or scented candles/incense but such association were no longer significant (at 0.1 level) after FDR correction.
- We tested the relative variation of 8 suspect phenols that were detected over 80% of the participants and did not find differences by daily use of lotion or scented candles/incense.

Stage 2 results:
- The detection (Y/N) of three suspect phenols (out of 14 suspects tested) were associated with daily use of lotion or scented candles/incense but such association were no longer significant (at 0.1 level) after FDR correction.
- We tested the relative variation of 8 suspect phenols that were detected over 80% of the participants and did not find differences by daily use of lotion or scented candles/incense.

Conclusion
- Our exploratory analysis suggest potential demographic differences in consumer product use and the presence of suspect phenols and phthalate metabolites in maternal serum.
- Daily consumer product use may be associated with the presence of suspect phenols and phthalate metabolites in maternal serum.
- Follow-up study with larger sample size is needed to examine exposures to these compounds among certain race/ethnicity and income groups.

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