Social Disparities in Phthalate Exposures: Implications for Women’s Health

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Phthalates in Consumer Products

- **Cosmetics and fragrances**
- **Toys and Home Furnishings**
- **Medical Devices**
- **Food and Food Packaging**

Photo credits: Campaign for Safe Cosmetics, Health Care without Harm
US population widely exposed to multiple phthalates
CDC NHANES 2009-2010 data

8 Phthalates detected in >90% of the population

Zota A.R. et al.. Environmental health perspectives. 2014
Phthalates are associated with adverse health effects at levels commonly found in the environment.

**Exposures during early life may contribute to:**

- Endocrine dysfunction
- Problems in male reproductive tract development
- Neurodevelopmental disorders
- Respiratory problems

**Exposures during adulthood may contribute to:**

- Endocrine dysfunction
- Pregnancy complications
- Chronic disease: Type 2 diabetes and obesity

### Economic burden of phthalates exposure in USA: ~60 billion dollars in 2010

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Burden of Disease</th>
<th>Economic Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult obesity</td>
<td>5900 cases</td>
<td>1.7 billion</td>
</tr>
<tr>
<td>Adult diabetes</td>
<td>1300 cases</td>
<td>91.4 million</td>
</tr>
<tr>
<td>Endometriosis</td>
<td>86,000 cases</td>
<td>47 billion</td>
</tr>
<tr>
<td>Male infertility</td>
<td>240,100 cases</td>
<td>2.5 billion</td>
</tr>
<tr>
<td>Low testosterone resulting in increased early mortality</td>
<td>10,700 attributable deaths</td>
<td>8.8 billion</td>
</tr>
</tbody>
</table>

Attina T.M. et al.. The Lancet Diabetes & Endocrinology 2016
Vulnerable Populations: Socially Disadvantaged Communities

Exposures and related health effects are inequitably distributed among populations within and between countries (FIGO Opinion)
Roadmap for Today’s Presentation

• Racial disparities in phthalates exposure
  • Individual phthalates
  • Cumulative exposures
• Drivers of racial exposure disparities
  • Proximate sources
  • Contextual/institutional upstream factors
• Implications for disparities in women’s health
  • Results of systematic review
  • Recommendations for future research
Black women have higher exposures to individual phthalates than other racial/ethnic groups.

Reproductive-aged women (n=739), NHANES 2001-2004

- Black
- Mexican American
- White

Branch et al. Environmental Health 2015
Black women have higher cumulative phthalate exposures than white women

- Multiple phthalates can have greater impacts than individual exposure
- NAS recommends them for cumulative assessment
- We developed a anti-androgenic potency-weighted sum of cumulative phthalates based on NAS recommendations
- Racial/ethnic differences persisted after controlling for SES
Synthetic Chemicals and Feminine Care

Photo Credit: Women's Voices for the Earth

Branch et al. Environ Health 2015
Vaginal Douching Use Associated with MEP

- Vaginal Douches
- Feminine Spray
- Feminine Powder
- Wipes/Towelettes
- Tampons

Douching mediates the race→ phthalates association (p<0.001)

Branch et al. 2015
Environmental Injustice of Beauty

Reframing beauty product purchasing and related chemical exposures within a broader social and economic context, thereby bringing it into conversations of environmental justice

Photo credits: Women Voices for the Earth; Blogspot/issatecargentina

Zota and Shamasunder, in progress
Synthetic Chemicals and Fast Food

- Food is an important exposure route for BPA and high molecular weight phthalates (e.g. DEHP)
- Fast food is highly processed, packaged, & handled

Study Design: 24 hour dietary recall data and urinary chemical biomarkers, NHANES 2001-2010 (n = 8,792)

- Fast food consumption is associated with higher DEHP and DINP, with evidence of dose-response.

<table>
<thead>
<tr>
<th>TEI (kcal)</th>
<th>$\Sigma$ DEHPm</th>
<th>% Difference (95% CI)</th>
<th>DINPm</th>
<th>% Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Ref</td>
<td>Ref</td>
<td></td>
<td>Ref</td>
</tr>
<tr>
<td>Moderate</td>
<td>4.3 (-3.7, 13.1)</td>
<td>6.2 (-2.5, 15.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>3.6 (-4.5, 12.3)</td>
<td>6.5 (-2.0, 15.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P for trend</td>
<td>0.39</td>
<td>0.13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fast food intake (% TEI from fast food)</th>
<th>$\Sigma$ DEHPm</th>
<th>% Difference (95% CI)</th>
<th>DINPm</th>
<th>% Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Ref</td>
<td>Ref</td>
<td></td>
<td>Ref</td>
</tr>
<tr>
<td>Low</td>
<td>15.5 (6.3, 25.6)**</td>
<td>24.8 (12.9, 37.9)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>23.8 (11.9, 36.9)**</td>
<td>39.0 (21.9, 58.5)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P for trend</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
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</table>

* p<0.01; ** p<0.0001

Model adjusted for age, sex, race, household income, BMI, urine creatinine, and NHANES cycle, survey population weights

Zota et al. 2016
Disproportionate Impacts among U.S. Blacks

"High" Fast Food Consumption

Greater fast food consumption among U.S. blacks

Steeper dose-response association between fast food and DEHP among U.S. blacks

Association between high fast food consumption and DEHP

Zota et al. 2016
Examining the linkages between race, fast food, and phthalates through an Environmental Justice lens

Residential Segregation and Uneven Regional Development

Neighborhood Built Environment
Fast food density, Availability of healthy food

Race/Ethnicity

Fast Food

Phthalates

Morello-Frosch and Lopez 2006; Morland et al. 2002
Systematic Review: Consumer product chemicals in US indoor dust

- Many phthalates detected in 95-100% of homes
- Phthalates occurred in highest concentrations (among 5 chemical classes studied)

Mitro et al. *Environmental Science and Technology* 2016
Indoor exposure disparities

- Lead
- PM$_{2.5}$
- Nitrogen dioxides
- Secondhand tobacco smoke
- 1,4 dichlorobenzene
- Chloroform
- Lead
- Pesticides
- PBDE flame retardants
- Cockroach allergens
Contribution of unequal environmental exposures to increasing risk of adverse health disparities across the life course

Adapted from Lu and Haflon in James-Todd et al. 2016
Do phthalates contribute to racial/ethnic differences in women’s reproductive health outcomes?

- Systematic review of four health outcomes: puberty, uterine fibroids, infertility and pregnancy complications.
- Accumulating evidence that phthalates may play a role in infertility and pregnancy complications.
- **Limitations:** Most studies only adjusted for race/ethnicity as a confounder and many studies were too racially homogenous to examine differential vulnerability.
- **Recommendations:** Need to examine effects of EDCs and women’s health outcomes in more diverse populations and use appropriate analytical techniques to assess how disparities in exposure may influence disparities in health outcomes.

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