Phthalates Exposures through Diet: Lessons Learned

NIEHS/EPA: Children’s Health Environmental Health Research Centers Webinars
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Phthalates

Diethyl Phthalate (DEP)
Dibutyl Phthalate (DBP)

Di-2-ethylhexyl Phthalate (DEHP)

Di-2-ethylhexyl Phthalate (DEHP)
Butylbenzyl phthalate (BBzP)
Phthalates: Health Impacts

- increased risk of preterm birth via inflammatory pathway
- reduced anogenital distance – risk factor for decreased male reproductive fertility/health
- changes in cord blood hormone concentrations
- inflammatory conditions: allergies and asthma

Routes of Exposure

- DEHP
- DBP
- DEP
- MEHHP
- MEHP
- MEOHP
- MEP
- MBP
Phthalate Exposure

- Ubiquitous and widespread

- Over 85% detection rate for DEHP, DEP, DBP, BBzP metabolites in 2009-2010 NHANES cycle

- Diet is a primary source of exposure for the high molecular weight phthalates
Dietary Sources of Phthalate Exposure

- To identify primary foods associated with phthalate exposure through a review of food monitoring and epidemiology data.

- To calculate daily dietary di-2-ethylhexyl phthalate (DEHP) based on typical food consumption patterns as well as poor and healthy diets for US women of reproductive age, adolescents, and infants.

Exposure calculated for 4 diets (typical, recommended by the United States Department of Agriculture (USDA), high meat/dairy, high vegetable/fruit):

- \( DI = \frac{Conc}{1000} \times CR \)

- \( DI \) = Daily Intake (µg/kg-day)
- \( Conc \) = Average phthalate concentration in food group (µg/kg food) based on all food monitoring data
- \( CR \) = Consumption rate of food group (g/kg body weight-day)

Total daily intake was the sum of exposure for 8 food groups.
Foods with High DEHP Concentrations (>300 µg/kg)

- Poultry
- Cream
- Cooking Oils/Fats

Foods with Low DEHP Concentrations (<50 µg/kg)

- Yogurt, Eggs
- Pasta, Rice, Noodles
- Fruits/vegetables
- Beverages

Serrano et al 2014
Figure 1: Per capita total DEHP intake (µg/kg-day) for four dietary patterns

Serrano et al 2014
Interventions to Reduce Exposures

Complete Food Replacement

1. Catered foods prepared without plastics for 3 days – found over 50% reduction in DEHP metabolite and BPA concentrations in 20 participants

2. Korean temple stay – 25 participants who ate a strict vegetarian diet for 5 days. Urine measured before and after the stay. All phthalates measured decreased.

Rudel et al. 2011, Ji et al. 2010
Pilot Study

Randomized Trial to Reduce Urinary Phthalate/BPA Exposures in 10 families with 2 children between ages of 4-8

**Arm 1:** Catered dietary intervention

**Arm 2:** Current educational handouts created by PEHSU

Hypothesis: Urinary phthalate and BPA concentrations will not decrease during the intervention period for Arm 2 participants but will significantly decrease for Arm 1 participants
Study Design

Days

Pre-Intervention  |  Intervention  |  Post-Intervention
---|---|---
1  |  2  |  3  |  6  |  7  |  11  |  12

Urine Sample Collection
Dietary Questionnaires
Pilot Study Results
## Pilot Study Results

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<thead>
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<th>Sample</th>
<th>Wt (g)</th>
<th>DEHP (ng/g)</th>
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<td>Mix 1</td>
<td>0.5670</td>
<td>2647</td>
</tr>
<tr>
<td>Mix 2</td>
<td>0.5774</td>
<td>69</td>
</tr>
<tr>
<td>Peanut Butter</td>
<td>1.2315</td>
<td>164</td>
</tr>
<tr>
<td>Cane Sugar</td>
<td>0.5946</td>
<td>&lt; 34</td>
</tr>
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<td>Milk</td>
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<td>673</td>
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_Sathyanarayana et al. 2012_
Lessons Learned

- Need more intensive intervention than one page handout

- Catered foods prepared with appropriate recommendations may not lead to reductions in exposures

- May take policy change to reduce exposures
Pilot Study #2

Days

Pre-Intervention  Intervention  Post-Intervention

1  5  7  14  21  26  28

Urine Sample Collection
Dietary Questionnaires
Reflection

- Original trial was not successful but led to a more successful model with education and fresh food delivery

- Still concentrations remain elevated

- Is the observed reduction in concentration enough to reduce risks from the chemicals?

- Should we reducing exposures in families and pregnant women when some would say there is not definitive evidence of harm?
Acknowledgements

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ALL OF OUR STUDY PARTICIPANTS!