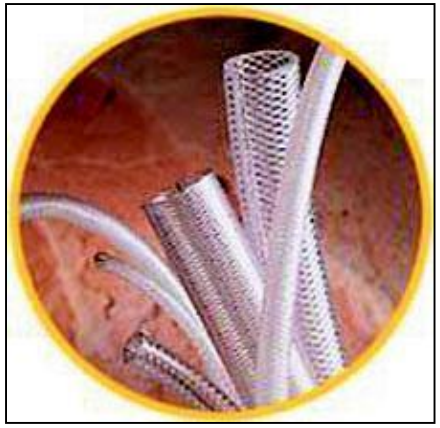
Phthalates Exposures through Diet: Lessons Learned

NIEHS/EPA: Children's Health Environmental Health Research Centers Webinars
June 10, 2015

Sheela Sathyanarayana MD MPH
Associate Professor, UW Pediatrics
Adjunct Associate Professor, UW Dept of Env and Occ Health Sciences
Investigator, Seattle Children's Research Institute

Phthalates

Diethyl Phthalate (DEP)
Dibutyl Phthalate (DBP)



Di-2-ethylhexyl Phthalate (DEHP)

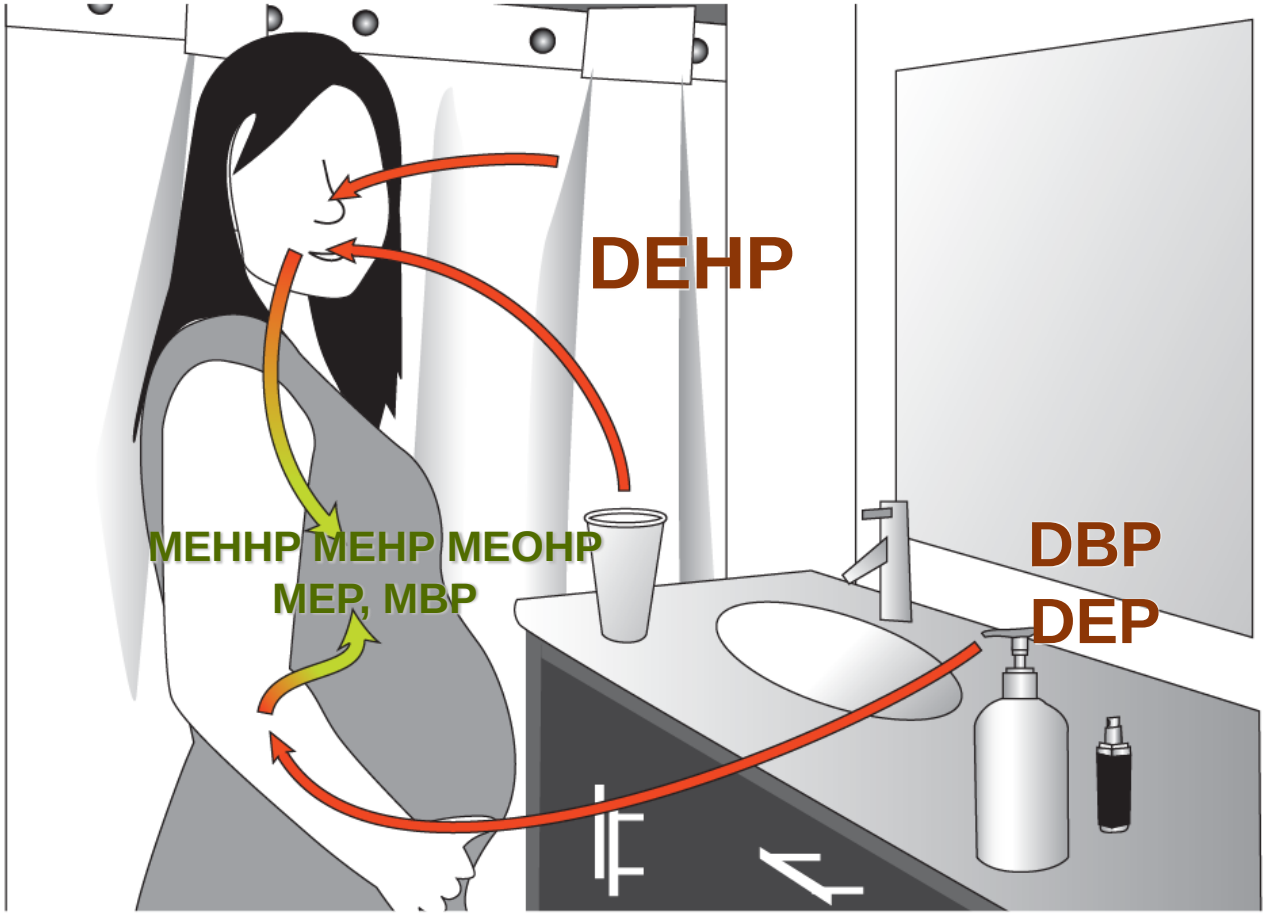
Di-2-ethylhexyl Phthalate (DEHP)
Butylbenzyl phthalate (BBzP)

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

Ferguson et al. 2013, Swan et al. 2005, Bornehag et al. 2004, Lang et al. 2008, Sathyanarayana et al. 2012, Braun et al. 2009, Shankar et al. 2011, Vandenberg 2007

Routes of Exposure



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 = Conc/1000 * 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

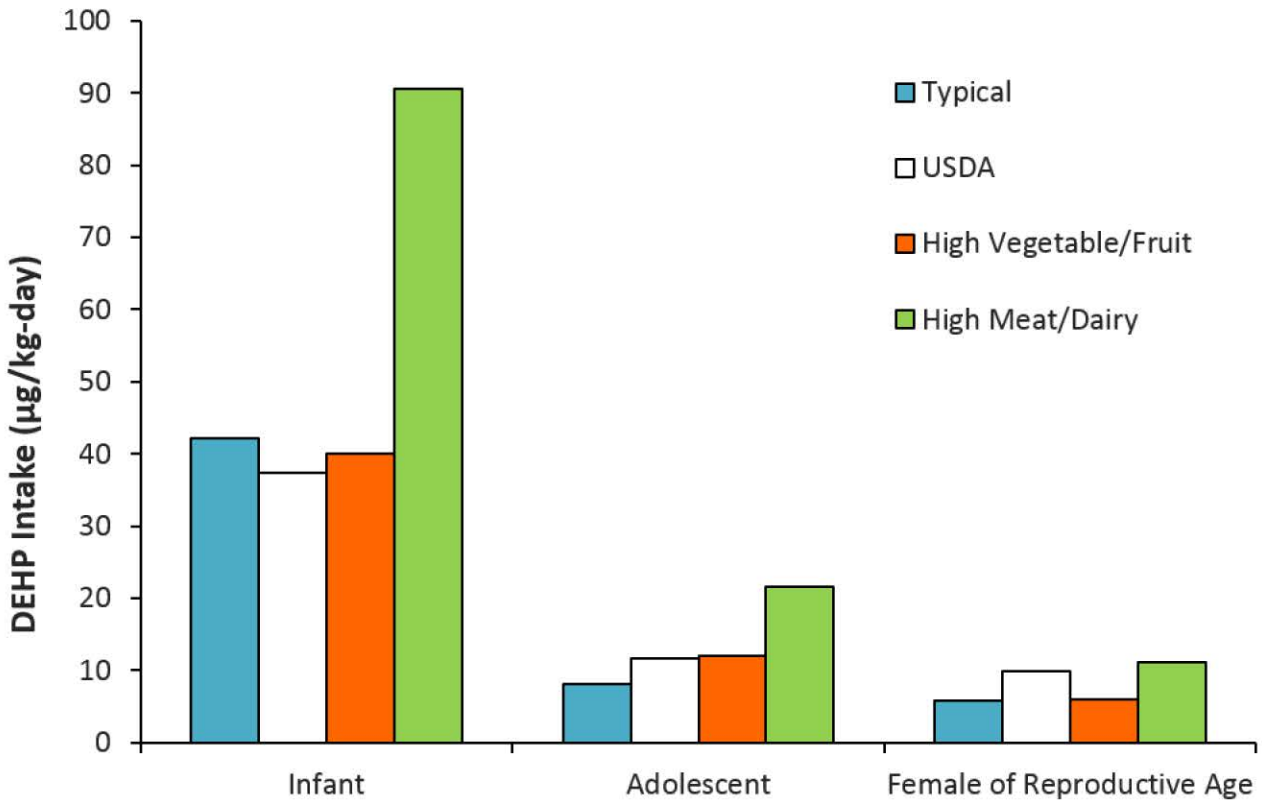


Figure 1: Per capita total DEHP intake (µg/kg-day) for four dietary patterns

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

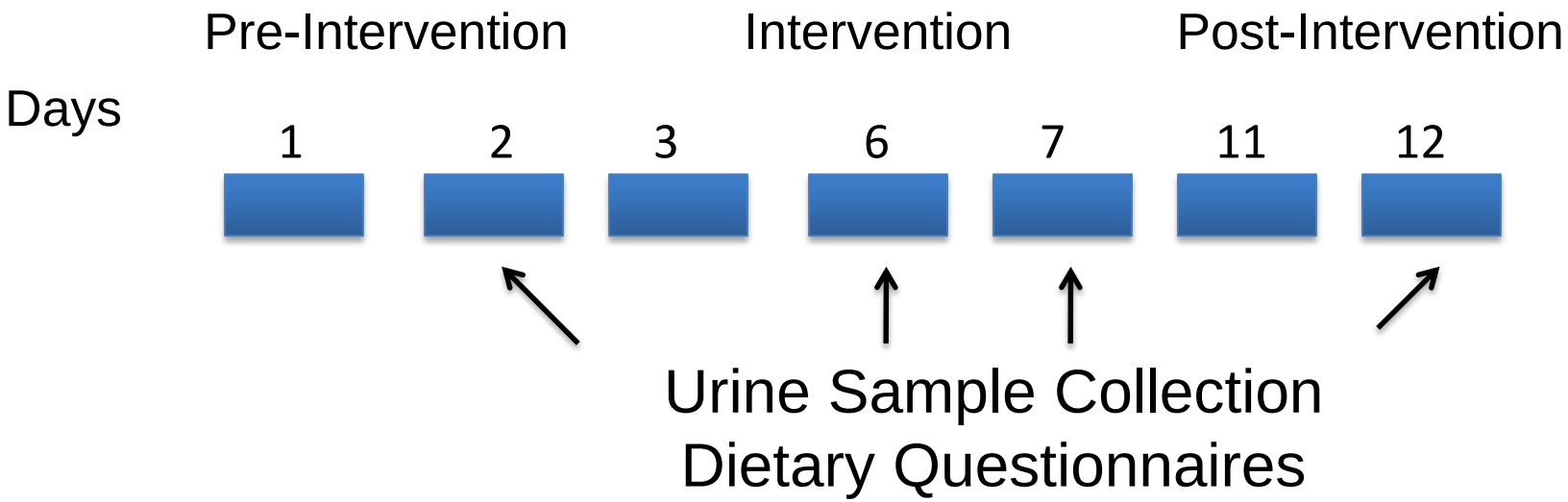
Randomized Trial to Reduce Urinary Phthalate/BPA Exposures in 10 families with 2 children between ages of 4-8

Arm 1: Catered dietary intervention

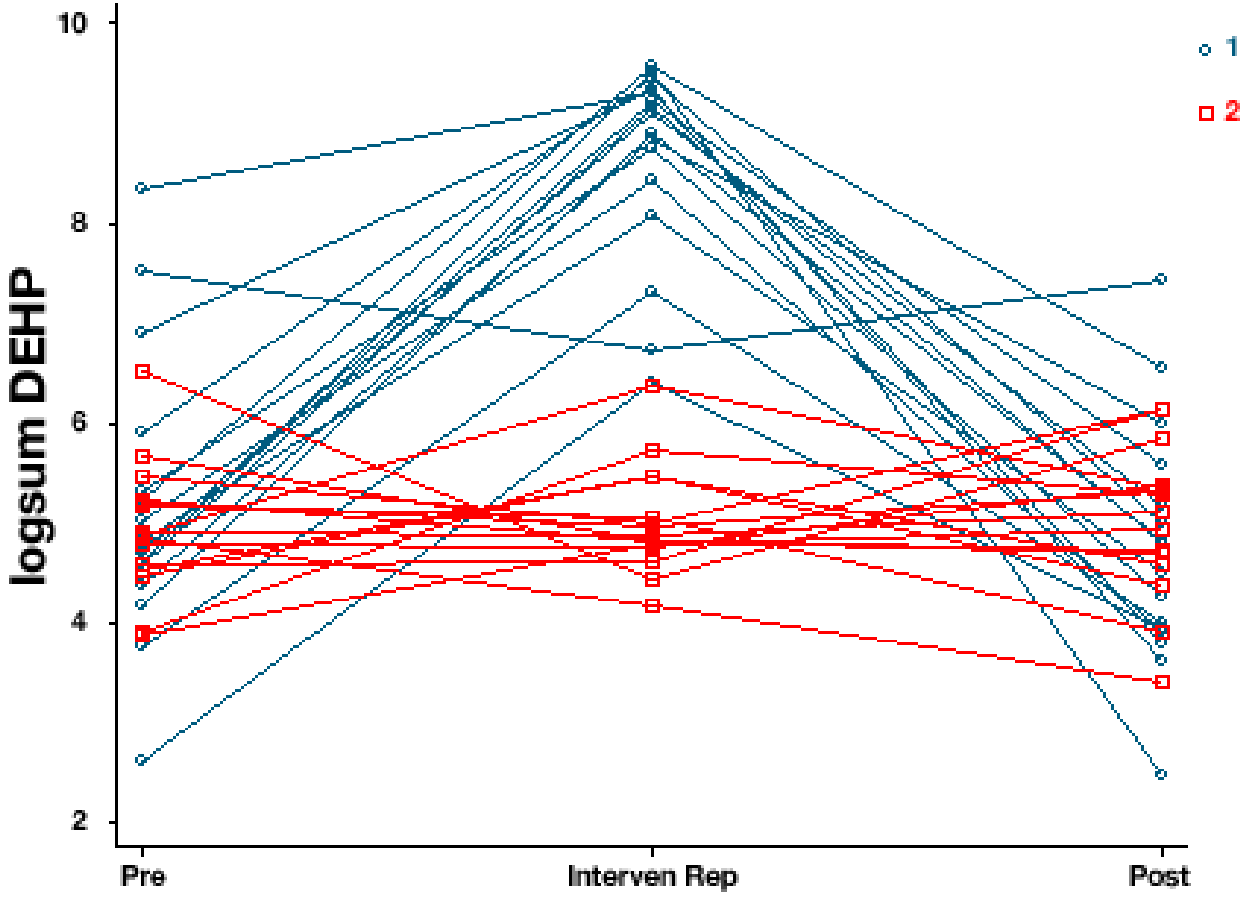
Arm 2: Current educational handouts created by PEHSU

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



Pilot Study Results



Pilot Study Results

Sample	Wt (g)	DEHP (ng/g)
Mix 1	0.5670	2647
Mix 2	0.5774	69
Peanut Butter	1.2315	164
Cane Sugar	0.5946	< 34
Milk	1.4742	673
Honey	0.7156	< 28
Egg Yolk	1.3174	39
Oats	0.6158	32
Cheese	0.6855	396
Pork	1.7385	25
Lamb	1.7427	49

Sample	Wt (g)	DEHP (ng/g)
Cayenne Pepper	0.7846	707
Star Anise	0.5714	<210
Ground Coriander	0.6510	21, 428
Cumin	0.6627	< 181
Ground Cinnamon	0.5438	958

Pilot Study Results

Sample	Wt (g)	DEHP (ng/g)
Mix 1	0.5670	2647
Mix 2	0.5774	69
Peanut Butter	1.2315	164
Cane Sugar	0.5946	< 34
Milk	1.4742	673
Honey	0.7156	< 28
Egg Yolk	1.3174	39
Oats	0.6158	32
Cheese	0.6855	396
Pork	1.7385	25
Lamb	1.7427	49

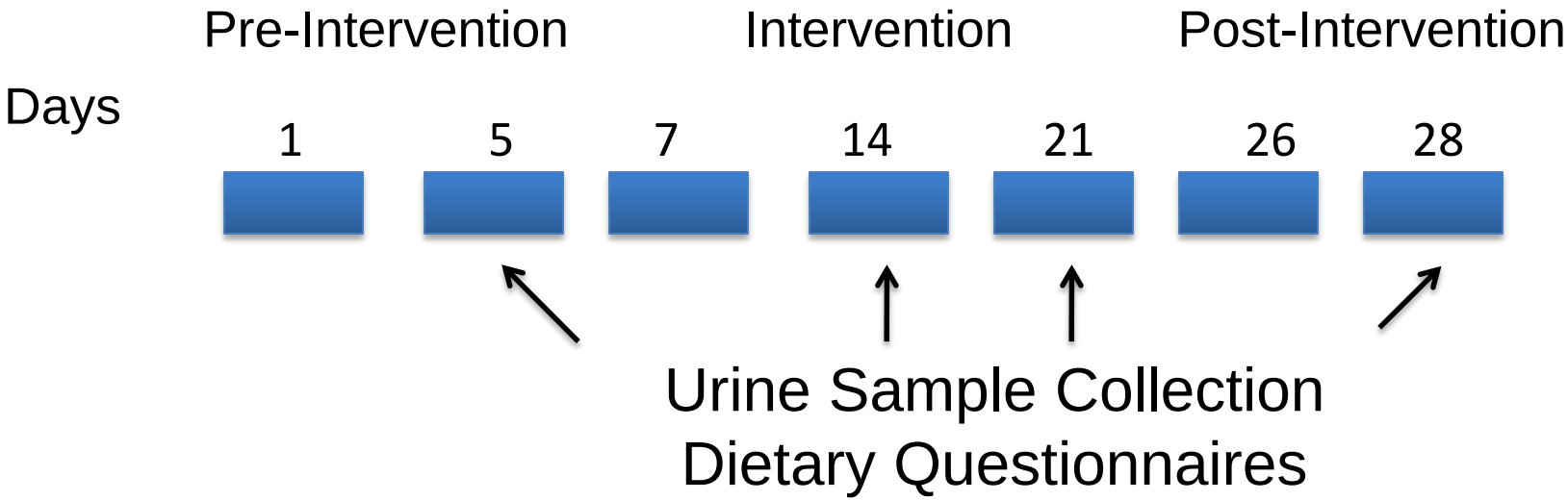
Sample	Wt (g)	DEHP (ng/g)
Cayenne Pepper	0.7846	707
Star Anise	0.5714	<210
Ground Coriander	0.6510	21, 428
Cumin	0.6627	< 181
Ground Cinnamon	0.5438	958

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



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

University of Washington/Seattle Children's Research Institute
Brian Saelens
Garry Alcedo
Russell Dills

Simon Fraser University
Bruce Lanphear

Funding: UW Center for Ecogenetics and Environmental Health, Seattle Children's Research Institute Stimulus Grants

ALL OF OUR STUDY PARTICIPANTS!