Impact of environmental policy on children’s exposure: Examining trends in biomonitoring of five environmental chemicals

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Disclosure

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No relationships to disclose
Support and Disclaimer

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• The findings and conclusions of this presentation do not necessarily represent the official views of EPA or ASPH.
Objectives

- Describe trends in children’s exposure
- List factors that may influence these trends
- Describe the potential impact of (selected) policy actions on trends in children’s exposure to:
  - Lead
  - Mercury
  - Perfluorochemicals
  - Bisphenol A
  - Perchlorate
- Discuss opportunities for decreasing children’s exposure through policy
Children’s environmental health

- Different environmental exposures
  - e.g. breastfeeding, prenatal exposure
- Physiological differences
  - e.g. immature immune systems, slower excretion from the kidneys
- Behavioral differences
  - e.g. hand-to-mouth behavior, crawling

Children are often more susceptible to environmental threats and thus may experience the most benefit from environmental policy
America’s Children and the Environment

- Periodic report from EPA that compiles data from various government sources
- Forthcoming 3rd edition: source of analyses in this presentation

For more information visit: www.epa.gov/ace
Biomonitoring data

- Data used in the ACE report were obtained from the National Health and Nutrition Examination Survey conducted by NCHS at CDC
- Data are representative of the U.S. civilian noninstitutionalized population
- Environmental chemicals are measured in blood and urine samples
  - Children of all ages participate, age groups differ by chemical
  - Women of child-bearing age (16-49 years) are another lifestage of concern for children’s health due to prenatal exposure
**Lead | Health Effects**

- Most sensitive health effect for children:
  - Neurological: IQ loss, impaired cognitive function, behavioral problems (occurs at blood lead levels <10 µg/dL)
  - No safe level of lead exposure!

Reference: ACE3
In the 1970s and 1980s, the three major sources of lead exposure were:
- Gasoline
- Soldered food cans
- Paint

Today, the main sources of lead exposure for U.S. children are:
- Deteriorating lead-based paint
- Lead contaminated dust

References: Pirkle et al. (1994). The decline in blood lead levels in the United States. *JAMA*.
The median blood lead concentration declined significantly (92%) between 1976-1980 and 2009-2010 (p<0.001), from 15 µg/dL to 1.2 µg/dL.
EPA sets first NAAQS for lead

1978: CPSC bans residential use of lead-based paint

1985: CDC lowers BLL of concern to 25 µg/dL

1986: EPA completes primary phase-out of leaded gasoline

1989: Testing and control of school drinking water recommended under ICCA

1988: Sale of leaded plumbing fixtures banned under SDWA Amendments

1991: CDC lowers BLL of concern to 10 µg/dL

EPA sets action level for lead in drinking water

1994: FDA sets action level for lead in children’s products

1995: FDA bans manufacture of lead-soldered food cans

1996: Sale of leaded gas for on-road vehicles banned

EPA and HUD require landlords to inform residents

1997: EPA establishes secondary lead smelter standards

2000: HUD’s Lead Safe Housing Rule

2001: EPA sets hazard standards for dust and soil

2008: EPA’s residential RRP rule

2009: New NAAQS for lead

Phase-out of lead in children’s products

Median blood lead concentration (µg/dL) in children ages 1-5 years
Lead | Policy Updates

• May 16, 2012: CDC concurs with ACCLPP recommendations and lowers the blood lead ‘reference value’ to 5 µg/dL

• Regulations currently under development at EPA:
  • Review of NAAQS for Lead (CAA)
  • Regulatory Revisions to National Primary Drinking Water Regulations for Lead and Copper (SDWA)
  • Review of Residential Lead Dust Hazard Standards (TSCA)
  • Lead Renovation, Repair, and Painting Program for Public and Commercial Buildings (TSCA)
  • Lead Wheel Weights (TSCA)
  • Lead Emissions from Piston-Engine Aircrafts (CAA)
Mercury | Health Effects

- Most sensitive health effect for children:
  - Neurological: delays in reaching developmental milestones and decreases in intelligence resulting from exposure to methylmercury
  - Prenatal exposure period is the most sensitive

References: ACE3; EPA (2007). TEACH Chemical Summary: Mercury..
Mercury | Exposure

- Primary exposure route for methylmercury:
  - Consumption of contaminated fish and marine mammals
- U.S. emissions have decreased over 50% in the past 20 years, but may account for as little as 3% of global emissions

Note: NHANES measures total blood mercury, which is expected to be representative of methylmercury exposure

Photo: http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/general.cfm
Median concentration of mercury in blood (µg/L) of women ages 16-49 years* and children ages 1-5 years

The median concentration of mercury remained stable during this time period for children (p=0.086) and women (p=0.934)

*Birth rate adjustment applied
Mercury | Policies

2001: EPA issues mercury fish tissue criterion
2003: EPA regulates mercury cell chlor-alkali plant emissions
2004: EPA and FDA publish advice on fish consumption for women
2005: EPA issues CAIR and CAMR
2006: EPA establishes voluntary mercury switch recovery program
2007: State regulations for mercury emissions from power plants
2008: Court vacates CAMR
2010: EPA issues measurement devices SNUR

Medication concentration of mercury in blood (µg/L)

- Women ages 16-49 years*
- Children ages 1-5 years

*Birth rate adjustment applied
95th percentile concentration of mercury in blood (µg/L) of women ages 16–49 years* and children ages 1–5 years

The 95th percentile concentration of mercury declined during this time period for children (p=0.025), but not women (p=0.563)

*Birth rate adjustment applied
Mercury | Policy Updates

- December 21, 2011: EPA issues Mercury and Air Toxics Standards for Power Plants (standards for new sources under technical review until March 2013)
- January 2013: Final meeting of UNEP’s Intergovernmental Negotiating Committee for mercury will be held
- U.S. ban on mercury exports in effect on January 1, 2013
- Regulations currently under development at EPA:
  - Boiler MACT Reconsideration (CAA)
  - Mercury; Use in Certain Products (TSCA)
  - SNUR; Elemental Mercury Used in Barometers, Manometers, and Hygrometers/Psychrometers (TSCA)
  - Review of Mercury Cell Chlor-Alkali Plants MACT (CAA)
PFCs | Health Effects

- Potential health effects for children:
  - Developmental and reproductive: low birth weight, reduced birth length, delays in postnatal growth and development, pregnancy loss

Reference: ACE3
PFCs | Exposure

- Used in industrial production since the 1950s (e.g. carpets, packaging products, nonstick cookware, fire-fighting foams)
- PFCs with highest production volume are PFOA and PFOS
- Exposure sources are poorly understood, but may include:
  - Food
  - Water
  - Indoor and outdoor air
  - Breast milk
  - Dust

Reference: ACE3
The median concentration of PFOS (p<0.001) and PFOA (p<0.001) declined between 1999-2000 and 2007-2008.
PFCs | Policies

Median concentration of PFCs in blood serum (ng/mL) of women ages 16-49 years*

- 2000: Voluntary phase-out of PFOS begins
- 2002: SNURs restrict new use of 88 PFOS-related chemicals
- 2005: ECAs call for research on incineration and PFOA
- 2006: PFOA Stewardship Program launches
- 2007: SNUR for 183 PFOS-related chemicals
  - State drinking water guidelines for PFOA

*Birth rate adjustment applied
PFCs | Policy Updates

• January 2009: EPA develops health advisories for short-term exposure to PFOA and PFOS in drinking water
• December 2009: EPA releases action plan for PFCs
• Regulations currently under development at EPA:
  • Long-Chain PFCs: Consideration of Regulations under TSCA
• July 2, 2012: FDA announces voluntary phase-out of chemicals similar to PFOA in food wrappers
BPA | Health Effects

- BPA may be an endocrine disruptor that could cause developmental, reproductive, immunological, and behavioral effects
- The National Toxicology Program at NIH concluded that there is “some concern” for effects of BPA on the brain, behavior, and prostate gland in fetuses, infants, and children

Reference: ACE3
BPA | Exposure

• Uses:
  • Epoxy resins and poly-carbonate plastics (e.g. food and drink containers, thermal paper receipts, contact lenses)
• Diet is the most common source of exposure, though exposure through other media (air, dust) may also occur

Note: Urinary BPA levels reflect recent exposure

Photo: http://www.ksro.com/GreenProducts/Story.aspx?id=1075132
The median concentration of BPA in urine declined over this time period for children (p<0.001), but not for women (p=0.523).
BPA | Policies

- Median concentration of BPA in urine (µg/L)

- Children ages 6-17 years
- Women ages 16-49 years*

**2008:** Some manufacturers and retailers phase-out certain BPA-containing products

**2009:** NTP finalizes report on BPA

**2010:** NRDC submits petition requesting prohibition of BPA in food packaging

**2010:** States ban BPA-containing food and drink containers

**EPA releases action plan for BPA**

**FDA releases interim report on BPA**

*Birth rate adjustment applied*
BPA | Policy Updates

- 2011-2012: Bans on BPA in children’s food and drink containers go into effect in a number of additional states
- March 30, 2012: FDA denies petition to eliminate BPA from food packaging, citing need for continued scientific research
- July 17, 2012: FDA bans BPA in baby bottles and sippy cups
Perchlorate | Health Effects

- Perchlorate is known to block uptake of iodide into the thyroid gland
- Iodide deficiency in pregnant women may lead to neuro-developmental deficits in their offspring

Photo: http://www.cancer.gov/cancertopics/pdq/treatment/thyroid/Patient/page1
Perchlorate | Exposure

- **Uses:**
  - Manufacture of fireworks, explosives, flares, and rocket fuel
  - May leach from natural sources in soil during irrigation
- **Exposure:**
  - Drinking water
  - Food

Note: Urinary perchlorate levels reflect recent exposure

Reference: ACE3
Map: http://www.ewg.org/node/8355
Perchlorate | Biomonitoring

Median concentration of perchlorate in urine (µg/L) of children ages 6-17 years and women ages 16-49 years*

The median concentration of perchlorate in urine did not change during this time period for children (p=0.702) or women (p=0.130)

*Birth rate adjustment applied
Perchlorate | Policies

- Median concentration of perchlorate in urine (µg/L)
  - Children ages 6-17 years
  - Women ages 16-49 years*

**Timeline of Events**
- **2001**: EPA begins monitoring perchlorate in public drinking water
- **2005**: EPA issues DWEL (24.5 ppb)
- **2006**: EPA issues cleanup guidance value (24.5 ppb)
- **2008**: EPA issues interim drinking water advisory (15 ppb)

*Birth rate adjustment applied
Perchlorate | Policy Updates

- February 2, 2011: EPA decides to develop enforceable drinking water standards for perchlorate
- Regulations currently under development at EPA:
  - National Primary Drinking Water Regulations: Regulation of Perchlorate (SDWA)
Conclusions

- Policies, including regulations and voluntary efforts, initiated at the national level appear to have played a role in reducing exposure to lead and PFCs.

- Although many regulations have addressed mercury, national policy efforts have only recently addressed the largest source of mercury emission in the U.S. and mercury emissions outside the U.S. remain high. Accordingly, the median exposure level has not declined.

- Levels of exposure to BPA and perchlorate have remained relatively stable over time in the absence of comprehensive and enforceable federal policy.
Thank You!

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