Association of phthalates, parabens and phenols in personal care products with pubertal timing in girls and boys

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Personal Care Products: What’s the Concern?

- The average woman uses 12 personal care products a day
- The average teenage girl uses 17
- More than 12,500 chemicals are used in cosmetics and personal care products

Source: Environmental Working Group
These Chemicals Can Enter our Bodies

- Ingestion
- Inhalation
- Dermal Absorption
Suspected Endocrine Disruptors in Personal Care Products

Phthalates
- Diethyl phthalate (DEP)
- Di-n-butyl phthalate (DBP)
- Di-isobutyl phthalate (DiBP)

Parabens
- Methyl Paraben (MP)
- Propyl Paraben (PP)

Antibacterials
- Triclosan (TCS)

Sunscreens
- Benzophenone-3 (BP-3)
Personal Care Products are the Main Source of Exposure

**Geometric Mean BP3 Levels (ng/ml)**

Used Sunscreen Past 24 hours?

- **No**: 100
- **Yes**: 500

*P-value < 0.01*

**Geometric Mean Propyl Paraben (ng/ml)**

- **Foundation Past 24 hours?**
  - **No**: 10
  - **Yes**: 40

*P-value < 0.01*

- **Blush Past 24 hours?**
  - **No**: 10
  - **Yes**: 40

*P-value = 0.05*

- **Mascara Past 24 hours?**
  - **No**: 10
  - **Yes**: 40

*P-value < 0.01*

Berger et al., 2018
Timing of Puberty in Girls is Getting Earlier

Girls reach puberty earlier, raising health concerns

Percentage of 7-year-old girls with early breast development:

- 1997: 5% Whites, 10% Blacks, 5% NA Hispanics
- 2010: 15% Whites, 15% Blacks, 15% NA Hispanics

Source: Pediatrics
By Frank Pompa, USA TODAY
Evidence Suggests this is a Global Phenomenon

Age of First Breast Development

p-value = 0.02

Age at onset of breast development has decreased by one year over past 40 years.

Eckert-Lind et al, JAMA Pediatrics, 2020
How Do We Measure Pubertal Timing?

Girls:
• Breast development (thelarche)
• Pubic hair development (pubarche)
• Menarche

Boys:
• Testicular volume >3 ml
• Genital development
• Pubic hair development

Trend towards earlier puberty in girls is quite well-established. Trend in boys is less clear.
Associations with Puberty: Animal Studies

- **LMW phthalates:**
  - Earlier puberty in female rats
  - Later puberty in male rats

- **Parabens:**
  - Earlier puberty in female rats
  - Later puberty in male rats

- **Triclosan:**
  - Earlier puberty in female rats

Mean age of onset of vaginal opening following an oral exposure to triclosan from PND 21 to 42 in the female pubertal assay
(From: Stoker et al, Tox Sci, 2010)

Research Question

Is timing of puberty in children associated with personal care product chemical exposure at two critical time points:

• In utero (biomarkers in maternal urine during pregnancy)
• Pre-puberty (biomarkers child urine at age 9)
CHAMACOS
Longitudinal Birth Cohort Study

Pregnancy
(two visits)

Birth
6 mo
2 yr
5 yr
9 yr
11 ¼ yr
12 ¾ yr
18 yr

1 yr
3 ½ yr
7 yr
10 ½ yr
N = 538

14 yr
16 yr

N = 338
Findings:
Associations with Timing of Puberty
Association of Prenatal Urinary Metabolites (continuous) and Puberty in Girls

Breast Development

Public Hair Development

Menarche

Adjusting for:
• Family income
• Mother’s education
• Mother’s years of residence in US
• Mother’s pre-pregnancy BMI

Harley et al, Human Repro, 2019
Quartiles of **Prenatal MEP and Puberty in Girls**

- Highest quartile of prenatal MEP associated with 5-6 months earlier pubertal onset

Harley et al, Human Repro, 2019
Quartiles of Prenatal Triclosan and Menarche in Girls

Triclosan = Antibacterial agent

- Highest quartile of prenatal Triclosan associated with 4 months earlier menarche

Harley et al, Human Repro, 2019
Association of Childhood (age 9) Urinary Metabolites (continuous) and Puberty in Girls

Breast Development

Pubic Hair Development

Menarche

Adjusting for:
- Family income
- Mother’s education
- Mother’s years of residence in US
- Mother’s pre-pregnancy BMI

Harley et al, Human Repro, 2019
Quartiles of Childhood (age 9) Methyl Paraben and Pubertal Milestones in Girls

Methyl paraben = preservative

- Highest quartile of childhood methyl paraben concentrations associated with 6 months earlier pubarche and menarche
Association of Urinary Metabolites (continuous) and Puberty in Boys

Harley et al, Human Repro, 2019
In Summary...

• Several chemicals in personal care products were associated with earlier puberty in girls ... but not boys.

• Associations with both prenatal and peripubertal exposures.

Prenatal:
• Highest maternal exposure to diethyl phthalate $\rightarrow$ 6 months earlier pubarche.
• Highest maternal exposure to triclosan $\rightarrow$ 4 months earlier menarche.

Peripubertal:
• Highest childhood exposure to methyl and propyl parabens $\rightarrow$ 6 months earlier.
Reasons for Caution

• First study to examine prenatal exposures to some of these personal care product chemicals

• Very specific population (low-income, rural Latinas in California)

• Urinary biomarkers reflect short-term exposures (24-48 hours)

• Associations with childhood exposures might reflect reverse causation.
Policy Implications

• We know that the chemicals in personal care products are getting into our bodies.

• Evidence that endocrine disrupting chemicals may be impacting pubertal timing

• The FDA has very limited authority over the cosmetics and personal care products industry

• Regulation of cosmetics is slowing starting to change (e.g. California Toxic-Free Cosmetics Act)
Switching your Products can Reduce Exposure!

- Enrolled 100 teen girls
- Collected pre-intervention urine sample
- Stop using regular personal care products for 3 days. Low chemical products instead.
- Collected post-intervention urine sample
Chemicals in the body decreased in 3 days

Harley et al., EHP, 2016

All p-values <0.01
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