Prenatal Exposures to Polycyclic Aromatic Hydrocarbons (PAH) and Childhood BMI Trajectories

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Childhood Obesity in NYC Elementary Schools by Ethnicity (2007-2008)

N=311,953

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td>21%</td>
<td>20%</td>
</tr>
<tr>
<td>Asian</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>Caucasian</td>
<td>16%</td>
<td>15%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>32%</td>
<td>26%</td>
</tr>
<tr>
<td>Other</td>
<td>18%</td>
<td>16%</td>
</tr>
</tbody>
</table>
Polycyclic Aromatic Hydrocarbons (PAH)

- PAH, particularly hydroxy-PAH, have been shown to have estrogenic effects.
- Induce estrogen-dependent cell proliferation.
- In adipocyte cell culture experiments B[a]P inhibit lipolysis.
- Shown to induce weight gain & gain in fat mass in mice.
- PAH are formed through incomplete combustion and are found in air pollution.
Columbia Center for Children’s Environmental Health Birth Cohort

- Pregnant African American and Dominican women were recruited during their 3rd trimester through prenatal clinics in N. Manhattan.

- Key entrance criteria: registered with OB/GYN clinic by 20th week of pregnancy, non-smoker, non-diabetic, non-hypertensive and lived in Bronx or N. Manhattan.

- Child’s height & weight measured at ages 5, 7, 9, 11 and again between ages 8.5 and 13.

- Assessment of metabolic syndrome between ages 8.5 and 13 – target N=400.
Studies of Chemical Exposures in the CCCEH Birth Cohort

- Pregnant women (n=702) wore personal air monitors for 2 days during pregnancy and 8 PAH were measured.

- PAH exposure measured as the sum of the 8 PAH.

- Confirmatory factor analysis identified a single factor explaining 80% of variance in the PAH data (Eigenvalue = 6.43). The Chronbach’s alpha for the 8 PAH = 0.86.
Conceptual Design of the CCCEH Birth Cohort Obesity Project

- Maternal Obesity
- Neighborhood social and physical context
- Childhood growth trajectories
- Prenatal PAH, BPA & Phthalate exposure
- Early life PAH, BPA & Phthalate exposure
- Risk of obesity and Metabolic Syndrome
BMI Percentiles in the CCCEH: Ages 5 and Age 7

- 21% are Obese
- 25% are Obese
Prenatal PAH Exposure is Associated with BMI Z-score at Age 5 & 7

Adjusted for age, gender, ethnicity, birth weight, maternal obesity and maternal receipt of public assistance [Rundle et al., AJE, 2012]
Childhood Growth Trajectories
Childhood Growth Trajectories
Repeated Measures in CCCEH

- 1,982 observations across 558 children: mean of 3.55 observations per child, 33 children with 1 observation and 193 with 5 observations.
Modeling Childhood BMI Growth Trajectories
Modeling Childhood BMI Growth Trajectories: Differences in Intercept
Modeling Childhood BMI Growth Trajectories: Differences in Intercept

Effect of exposure on BMI by Age intercept
Modeling Childhood BMI Growth Trajectories: Differences in Slope
Modeling Childhood BMI Growth Trajectories: Differences in Slope

Effect of exposure on slope of BMI by Age
Childhood BMI Growth Trajectories: Differences in Intercept and Slope
Prenatal PAH and Childhood BMI Growth Trajectories

Intercept effect: 0.44 BMI units at age 5 per unit \( \ln \) PAH (95% CI 0.13, 0.75).

Slope effect: -0.002 difference in slope per unit \( \ln \) PAH (95% CI -0.01, 0.01).
Latent Class Growth Models

• LCGM identify distinct subgroups of subjects who have similar underlying growth trajectories over time.

• Conceptually, growth trajectories are estimated for each subject and then cluster analyses are applied to the population of trajectories to identify latent classes.

  ➢ Applied LCGM to identify children that have similar BMI by age growth trajectories from age 5 to 12 years of age.
Latent Class Growth Models of BMI by Age Data in the CCCEH

BMI vs Age in Months
CNorm Model

Age in Months
Group Percents 55.3 9.7 35.0
Latent Class Growth Models of BMI by Age Data in the CCCEH

**Class 1:** reflects the growth curve of a child at the ~50\textsuperscript{th} percentile on the CDC growth charts ("Healthy" trajectory - 55\% of children).

**Class 2:** reflects children who were overweight at age 5 and whose growth curve accelerated into the obese category by age 12 ("Overweight-to-obese" trajectory class - 35\% of children).

**Class 3:** reflects children who were already obese at age 5 and whose growth accelerates upwards through age 12 ("Obese-to-highly obese" trajectory class - 10\% of children).
Association between Prenatal PAH and Latent Class of BMI by Age

**OR = 1.76 (1.07, 2.88)**

**OR = 1.17 (0.87, 1.57)**
Conclusions

- Prenatal PAH exposure is associated with higher BMI Z-score at age 5 and 7.
- The effect of PAH exposure on childhood body size carries forward into adolescence.
- Prenatal PAH exposure is associated with a pattern of childhood growth characterized by obesity by age 5 and accelerated weight gain through age 12.
Collaborators

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