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

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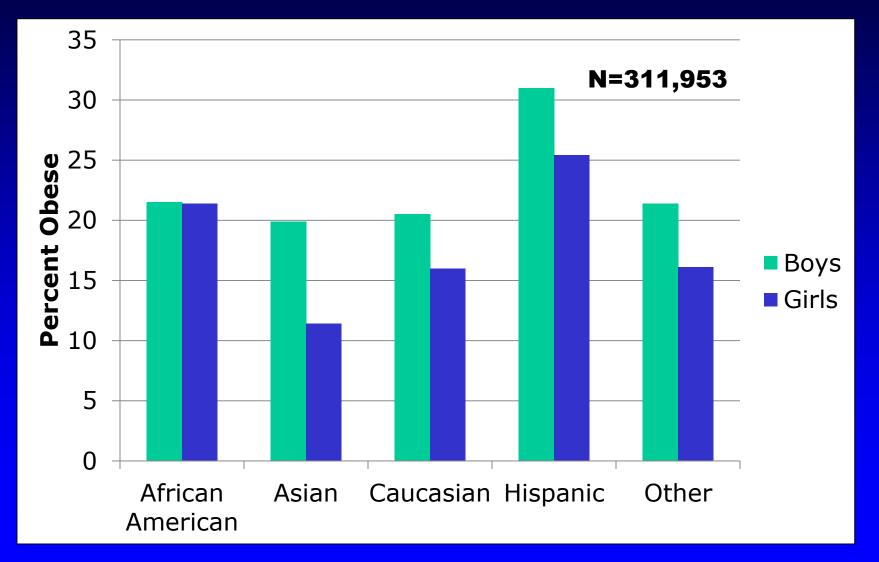**Associate Professor of Epidemiology
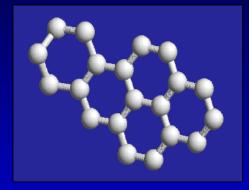Co Director of the Mailman School Obesity
Prevention Initiative**

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

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.

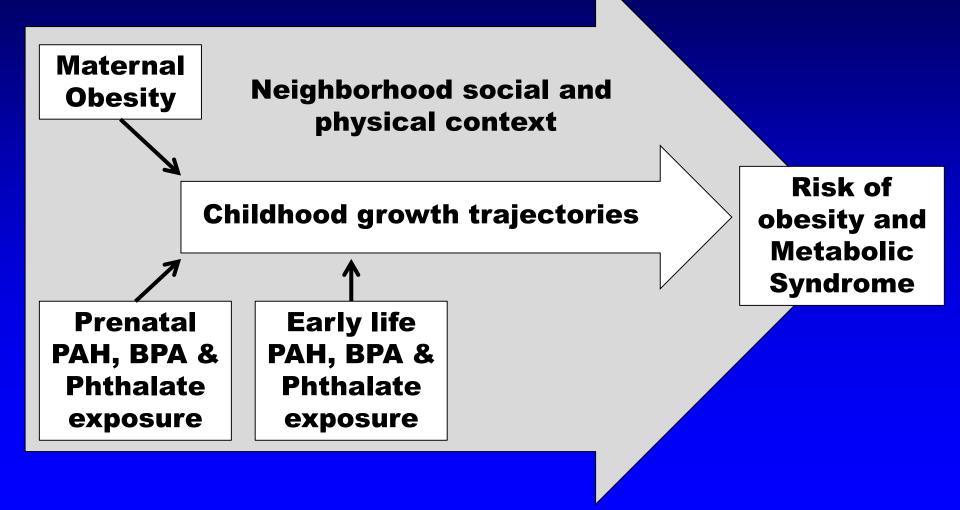# Columbia Center for Children's Environmental Health Birth Cohort

- 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.

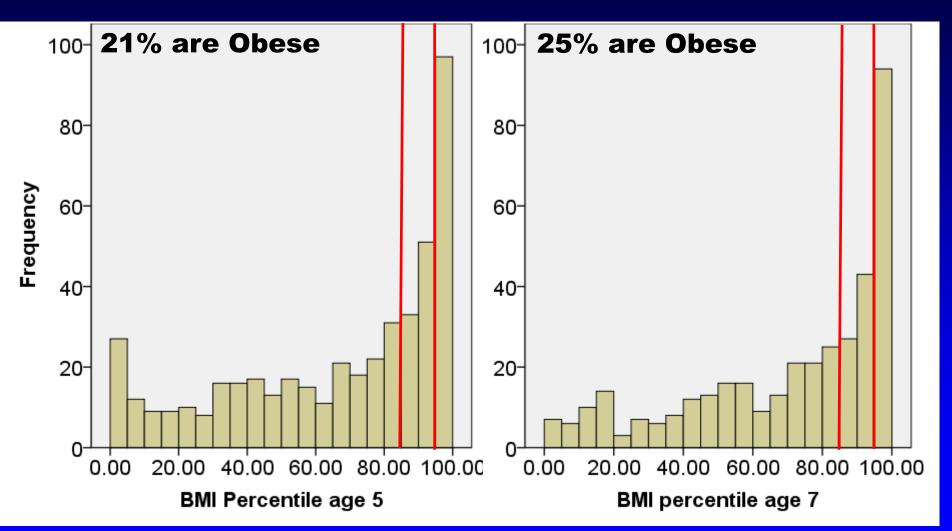# Studies of Chemical Exposures in the CCCEH Birth Cohort

- 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.
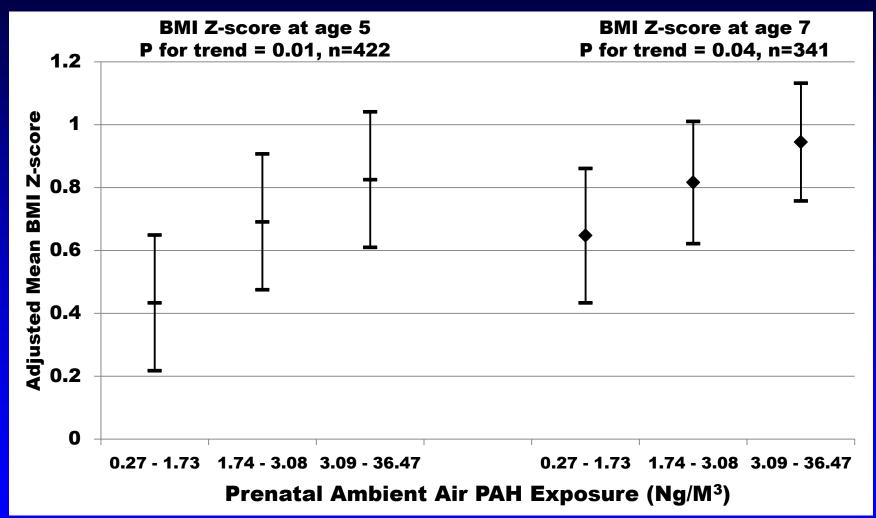
Conceptual Design of the CCCEH Birth Cohort Obesity Project

Maternal Obesity

Neighborhood social and physical context

Childhood growth trajectories

Risk of obesity and Metabolic Syndrome

Prenatal PAH, BPA & Phthalate exposure

Early life PAH, BPA & Phthalate exposure

BMI Percentiles in the CCCEH: Ages 5 and Age 7

Prenatal PAH Exposure is Associated with BMI Z-score at Age 5 & 7

BMI Z-score at age 5
P for trend = 0.01, n=422

BMI Z-score at age 7
P for trend = 0.04, n=341

Y-axis: Adjusted Mean BMI Z-score (0, 0.2, 0.4, 0.6, 0.8, 1, 1.2)

X-axis categories: 0.27 - 1.73 | 1.74 - 3.08 | 3.09 - 36.47 | 0.27 - 1.73 | 1.74 - 3.08 | 3.09 - 36.47

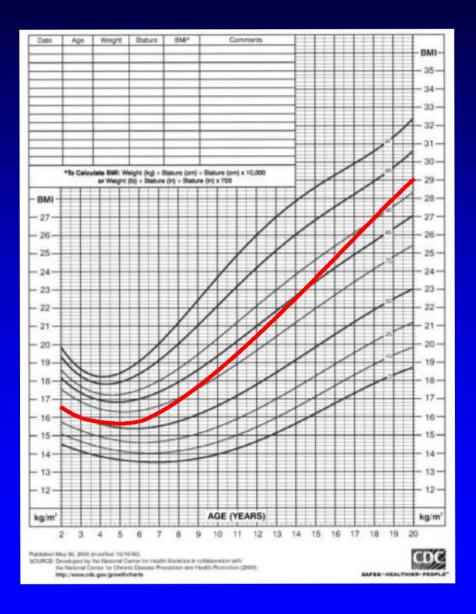X-axis label: **Prenatal Ambient Air PAH Exposure (Ng/M^3)**

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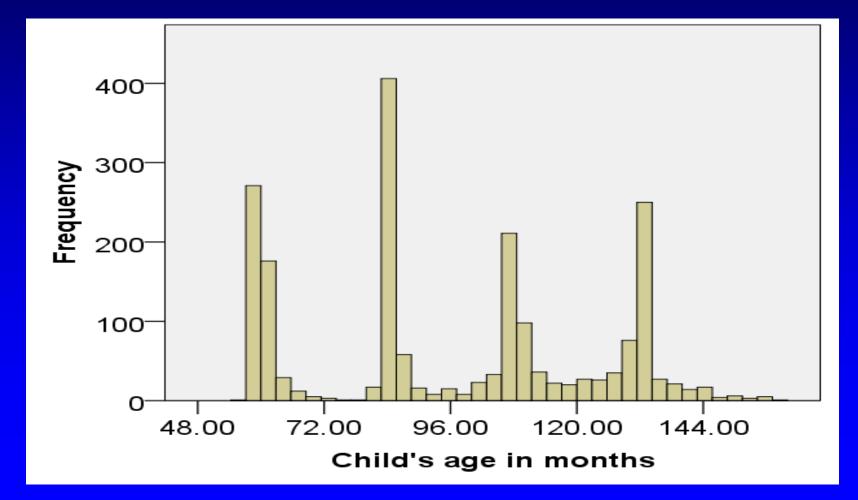
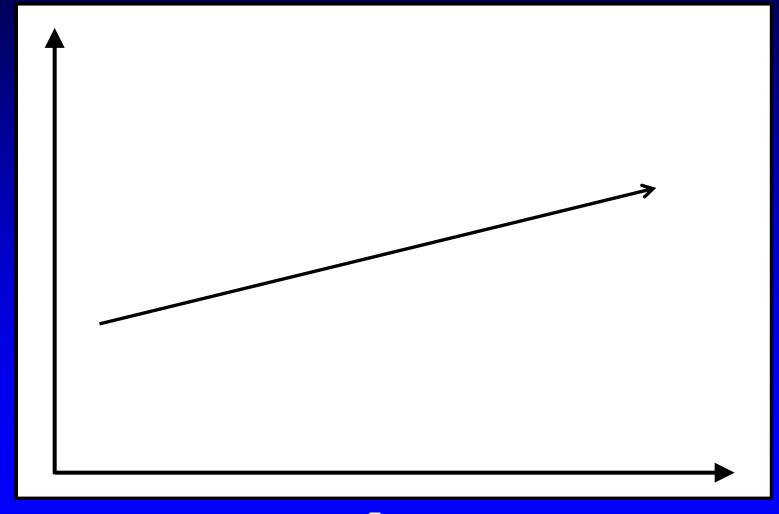# Childhood Growth Trajectories

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.
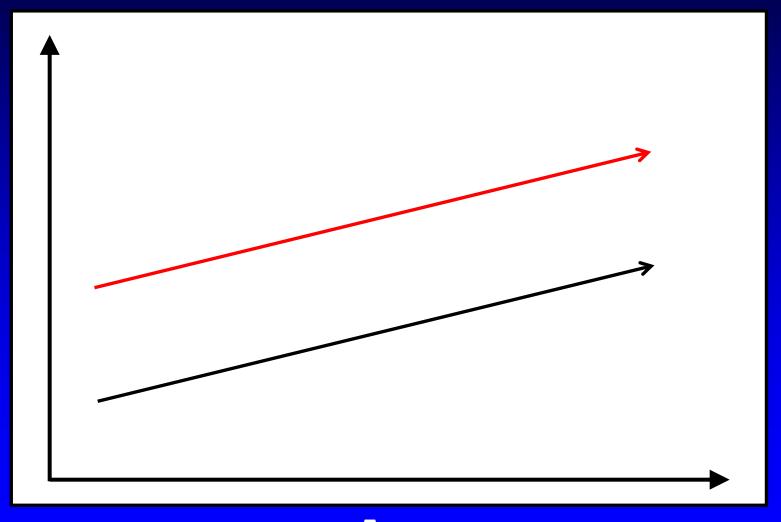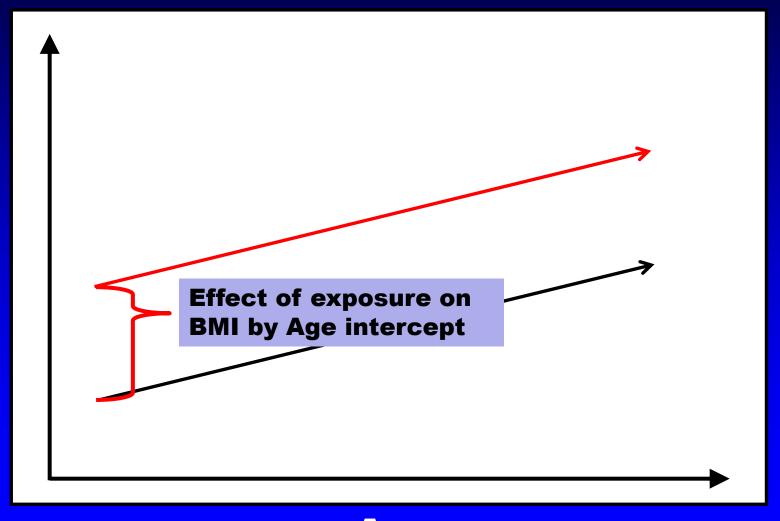
Modeling Childhood BMI Growth Trajectories

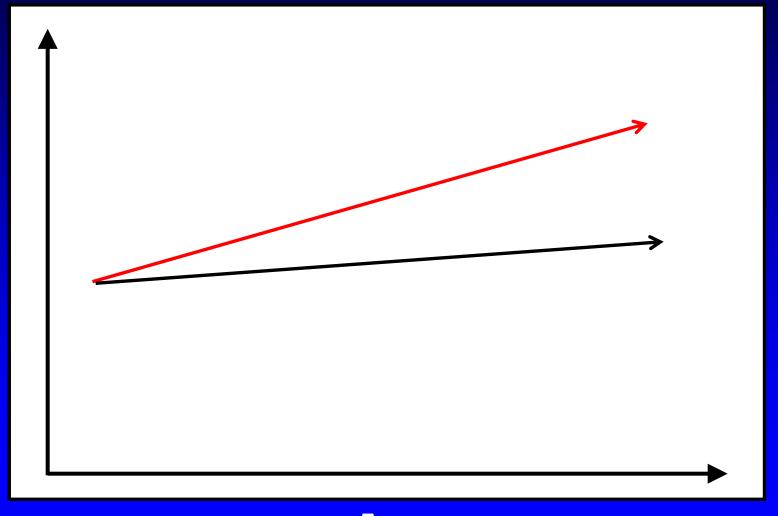# Modeling Childhood BMI Growth Trajectories: Differences in Intercept

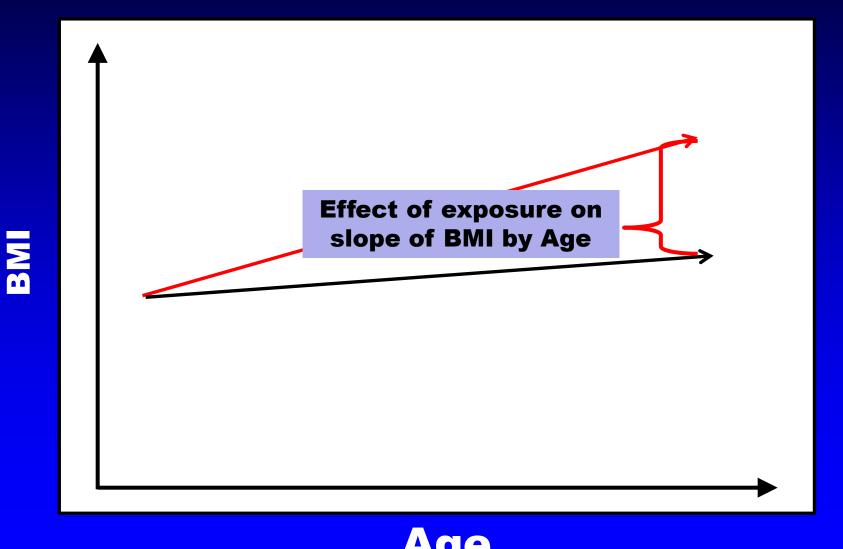# Modeling Childhood BMI Growth Trajectories: Differences in Intercept

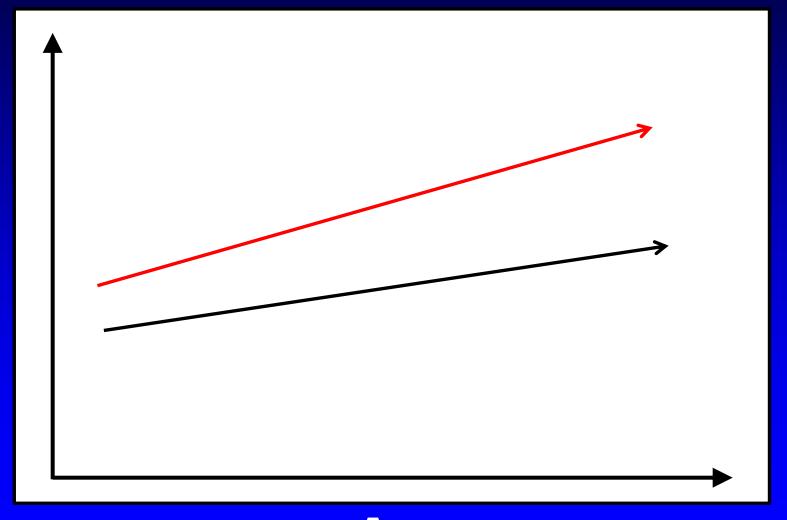# Modeling Childhood BMI Growth Trajectories: Differences in Slope

Modeling Childhood BMI Growth Trajectories: Differences in Slope

BMI

Effect of exposure on slope of BMI by Age

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).

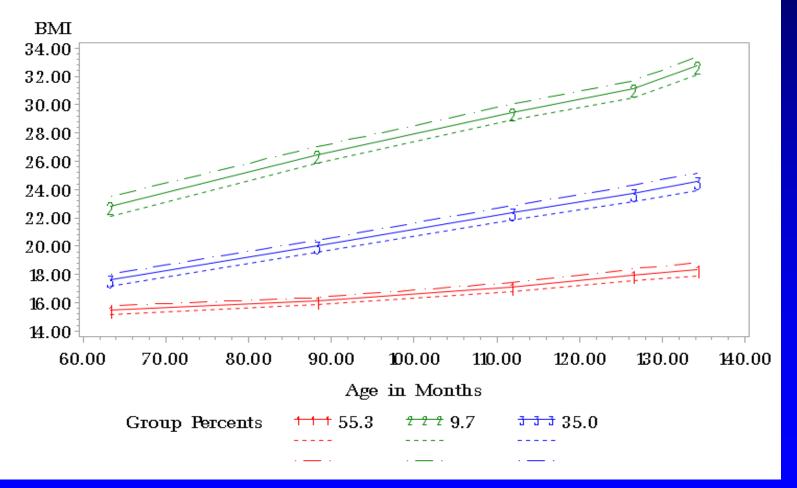**Slope effect: -0.002 difference in slope per unit Ln PAH (95% CI -0.01, 0.01).**

BMI

Age

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

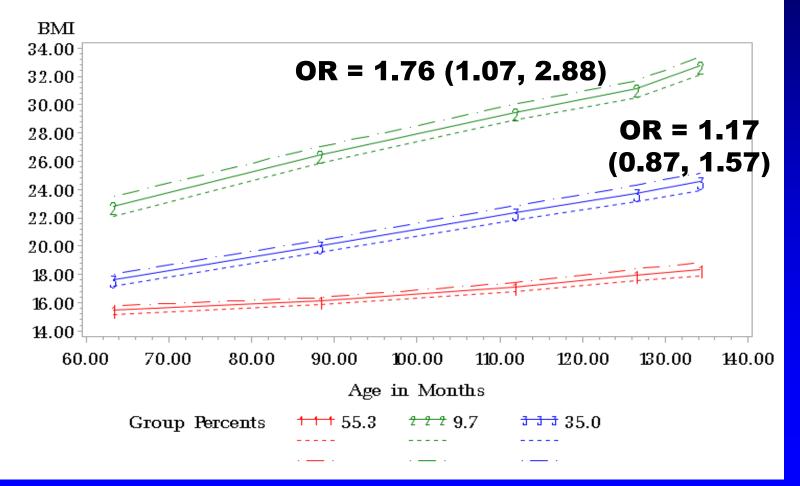# Latent Class Growth Models of BMI by Age Data in the CCCEH

Class 1: reflects the growth curve of a child at the ~50th 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

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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