Emerging Science and Birth Center Challenges
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Background

• 300 million pounds of glyphosate (GLY) (Roundup®) are applied each year in the US

• Though glyphosate has been in use since 1974, no previous measures of GLY exposure in US pregnancies have been published

• Rodent models of pesticide exposure in pregnancy correlate with adult and transgenerational disease through epigenetic mechanisms

• Measured GLY in pregnant women to estimate fetal exposure and potential adverse effects on pregnancy outcomes
Environmentally Induced Epigenetic Transgenerational Disease

How does it work?

- Chemicals (or stressors) in environment
- Induce DNA methylation of genome (in child, adolescent or fetus)
- Which alters adult disease risk (shifts in gene expression)
- And can be transmitted to future generations

Pregnant Rat

Vinclozolin Methoxychlor

F0

F2

F1

F0

Vinlozolin Exposure (PC days 8-14)

Offspring
Failed Experiment!
The Baby Rats Were Normal

6 mos

Adult Rats had Diseases

Fetal Exposure: Adult disease

- Low sperm count
- Infertility
- Cancer
- Kidney
- Prostate
- Pregnancy abnormalities
- Immune dysfunction
- High cholesterol
- Accelerated aging
- Non “Sexy” scent
- Anxiety prone
Transgenerational Effects of Fetal Pesticide Exposure

![Graph showing percent disease prevalence across different organs for generations F1 to F4.]

Declining Age of Menarche (Japan)

![Graph showing age of menarche across decades and percentage of girls menarche <11 years.]

BMC Women's Health 2012 Jul 16;12(1):19
Hosokawa, Imazeki, Mizunuma, Kubota, Hayashi
Males Developing 2 years Earlier Too!

Age to 3ml Testicular Volume
(US white male) Pediatrics 2012

New Study: Objectives

Prospective cross-sectional birth cohort study to measure:
• How many Midwest pregnant women are exposed to glyphosate (GLY) ?
• Is drinking water an important source of exposure?
• What risk factors and adverse pregnancy outcomes correlate with exposure?
Design/Methods

- Pregnant women ages 18-40 years, newborn infants enrolled prospectively at a private obstetrical practice
- Same day urine and household water samples were collected during a subsequent clinical visit
- Urine and water samples were measured for GLY in ng/mL with liquid chromatography-tandem mass spectrometry (LLOQ 0.5 ng/mL)

Design/Methods, continued

- Electronic medical records reviewed and pregnancy outcome data were collected
- Food and water consumption questionnaires administered during pregnancy
- Statistical linear models used to assess relationships between GLY level and clinical outcomes of gestation age and adjusted birth weight, as well as pregnancy-related risk factors
Study Population

- A total of 69 pregnant women with live-born infants were studied
- 69 drinking water samples were tested
- Mean maternal age was 29 years (range 18-39 years)
- Maternal race was 94.2% Caucasian, 7.8% Asian

Results

- 65 of 69 pregnant women (91%) tested positive for GLY (>LLOD)
- Mean GLY concentration was 3.6 ±0.12 ng/mL
- None of the drinking water samples had detectable GLY, suggesting that diet and beverages likely source of exposure
### Fetal Exposure: Chemicals

Tracey J. Woodruff, Ami R. Zota, Jackie M. Schwartz, EHP, 2011; Paul Winchester, Shahid Parvez, Cathy Proctor, Jun Ying, Roy Gerona PAS SFO 2017

#### Chemicals in Pregnant Women

![Bar chart showing the percentage of women with detectable levels of various chemicals](chart1.png)

#### Maternal Weight vs. Glyphosate Levels

2.50 2.70 2.90 3.10 3.30 3.50 3.70 3.90

Healthy weight Overweight Obese

GLYPHOSATE (ng/mL)

MATERNAL BMI

GLYPHOSATE VS. MATERNAL BMI (PREPREGNANCY)

- Healthy weight
- Overweight
- Obese

R = .286
p = .017

Prepregnancy BMI (kg/m²) vs. Glyphosate (ng/mL)

Group 3
Pre-pregnancy Obesity (≥ 30 BMI) vs. GLY

Caffeine vs. Glyphosate

Do you currently consume beverages containing caffeine (coffee, caffeinated soda, tea, energy drinks)?
Pregnancy Length vs. Glyphosate

* Only includes singleton ≥37 week gestation infants.

Gestation-Corrected Birth Weight (Bwt %tile) vs. Glyphosate

* Only includes singleton ≥37 weeks gestation infants
Summary

• The most heavily used pesticide in the US is found in over 90% of pregnancies in a Midwestern state
• Higher GLY levels were associated with shorter gestations and with lower gestation-adjusted birth weights
• Since water samples were largely negative, the source of exposure is probably food
• Maternal pre-pregnancy weight and caffeine intake were associated with higher GLY

Study Implications

• The majority of fetuses must be assumed to have exposure to glyphosate during critical periods of fetal development
• Policy makers need to ensure that significant increases in herbicide use and fetal exposures in the Midwest do not result in altered DNA methylation and potential multigenerational disease
Limitations

- Small sample size and regional and demographic differences are not addressed — but study is ongoing, with many more samples by the end of 2017
- No $$ to exam GLY variability by trimester and comparisons in blood
- GLY residues in food not addressed

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