

Glyphosate in 1st Trimester of Pregnancy: Herbicides in the Womb?

¹Winchester, Paul; ¹Reiter, Jill L; ¹Proctor, Cathy; ²Gerona, Roy R; ¹Avery, Kayleigh D;
¹Bromm, Jennifer R; ¹Elsahy, Deena A; ¹Hadley, Emily A; ¹McGraw, Sara N; ¹Jones, Dana D.

¹Indiana University School of Medicine, Indianapolis Indiana; ²University of California San Francisco, San Francisco California

ABSTRACT

TITLE: Glyphosate in 1st Trimester of Pregnancy: Herbicides in the Womb?
Background: Our previous study demonstrated that >90% of pregnant Midwest women had detectable glyphosate (GLY) in their urine. Most glyphosate exposure occurs through food & certain beverages but not through drinking water. Shorter pregnancies, rural address and caffeinated beverages were associated with higher GLY levels. The cohort was small and predominantly Caucasian. The current study was needed to confirm high rates of GLY detection in a racially more diverse high risk population.
Objective: Will GLY be detected in a majority of pregnancies regardless of race/ethnicity? Are GLY levels associated with adverse pregnancy outcomes? Do GLY levels vary by season of collection in pregnancy?
Design/Methods: Prospective observational study. Discarded urine from 1st trimester pregnancies were collected prospectively from a high risk University obstetrical clinic. All pregnancy outcomes and neonatal outcomes were abstracted. Urines were frozen, shipped to analytical lab (USCF, RG) for analysis. Urine GLY (Glyphosate (N-(phosphomethyl) glycine) was analyzed via liquid chromatography-tandem mass spectrometry (LC-MS/MS), limit of quantification of 0.1 ng/mL. GLY measured as independent variable was compared to multiple variables using bivariate analysis.
Results: GLY was detected in 99% (186 of 187) pregnancies. Levels varied from 1.004 to 10.31ng/mL with geometric mean 3.264ng/mL. Mean maternal age was 30, with 69% white, 4.2% Hispanic, 12% Black, 3.7% Asian and one "other". GLY levels did not differ significantly by racial/ethnic group. GLY levels were not significantly different between preterm and term outcomes, multiple/singleton or between fetal loss and live births. GLY levels were higher with increasing gestation at enrollment with 4-8 weeks vs. 9-13 weeks (2.73 vs. 3.51, p=.0098). Significantly higher GLY levels were found in April-July pregnancies vs other months (3.64 vs 3.07, p=.03). NICU admission rates were 85% for preterm and 35% for term. Birth defect rate was 12% and 37% had intrauterine drug exposure or NAS. Preterm birth rate was 31%.
Conclusion(s): Glyphosate was found in virtually all of these high risk pregnancies in the first trimester regardless of race/ethnicity, plurality, fetal loss or gestation at birth. GLY levels rose with increasing gestation in the first trimester suggesting that gestation at measurement impacts GLY levels. Dietary sources contribute to GLY but we did find April-July are associated with higher GLY levels than other months. The fetal epigenetic consequences of 1st trimester GLY exposure remains unknown.

BACKGROUND

Our previous study demonstrated that >90% of 71 pregnant Midwest women had detectable glyphosate (GLY) levels in their prenatal urine. That study found that most glyphosate exposure occurs through food and certain beverages but not through drinking water. Shorter pregnancies, rural address and caffeinated beverages were also found to be associated with higher GLY levels. The cohort was small and predominantly Caucasian. The current study was needed to confirm high rates of GLY detection in a racially more diverse population.

Objective: Will GLY be detected in a majority of pregnancies regardless of race/ethnicity? Are GLY levels associated with adverse pregnancy outcomes? Do GLY levels vary by season of collection in pregnancy?

MATERIALS and METHODS

Prospective observational study randomly collected 187 discarded first trimester urines from a high risk University Obstetrical Clinic. Samples were frozen -20°C and stored. Study population consisted of 187 mother-baby pairs. Medical charts were reviewed and all pregnancy and neonatal outcomes were abstracted and analyzed. Urine samples were analyzed for Glyphosate (N-(phosphomethyl)glycine) using LC-MS/MS with an LOQ of 0.1 ng/mL Primary independent variable, urinary GLY levels, was compared to pregnancy and neonatal outcomes using bivariate analysis.

GLYPHOSATE VS. RACE, GESTATION, & MONTH/YEAR OF COLLECTION

- GLY was detected in 99% (n=187) pregnancies. Levels varied from <LOD to 10.31 ng/mL with geometric mean 3.26 ng/mL.
- Mean maternal age was 30, with 67.4% Non-Hispanic White, 4.3% Hispanic, 21.9% Non-Hispanic Black, 3.7% Non-Hispanic Asian and 1.0% unknown and were not significant (Figure 1).
- GLY levels were not significant between male and female, preterm and term outcomes, multiple/singleton or between fetal loss and live births.
- Mean GLY levels were higher with increasing gestation at enrollment with 4-8 weeks vs. 9-13 weeks (2.73 vs. 3.51, p=.0098) (Figure 2).
- Mean GLY levels in pregnancy rose each year of the study period with 2013 vs. 2016 (2.8 vs. 3.51, p=.03.) (Figure 3).
- Significantly higher mean GLY levels were found in April-July pregnancies vs. other months (3.64 vs. 3.07, p=.03) (Figure 4).

Figure 1

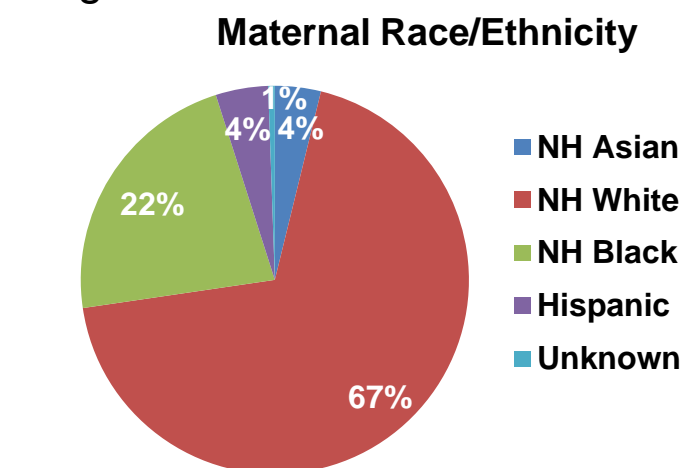


Figure 2

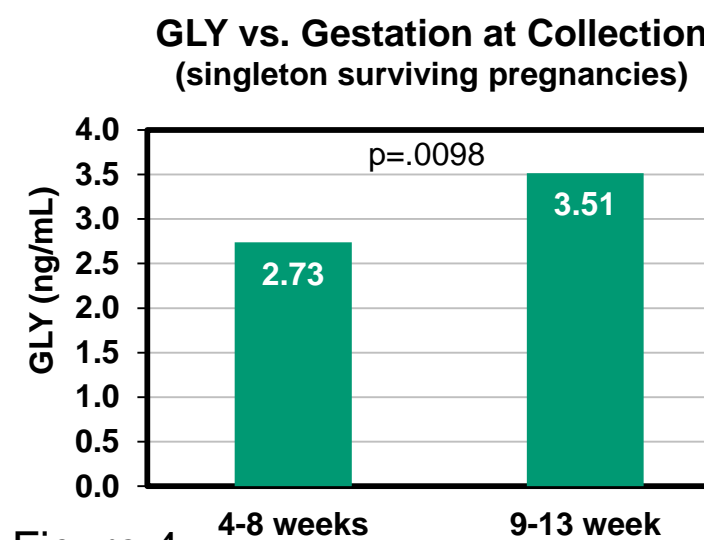


Figure 3

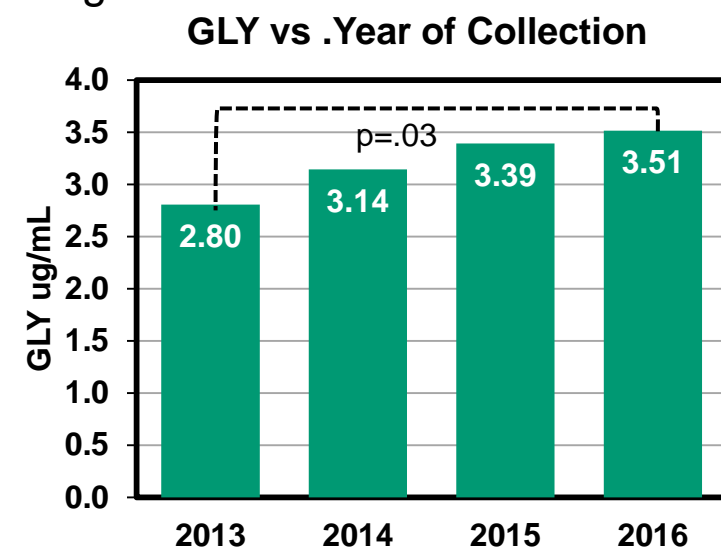
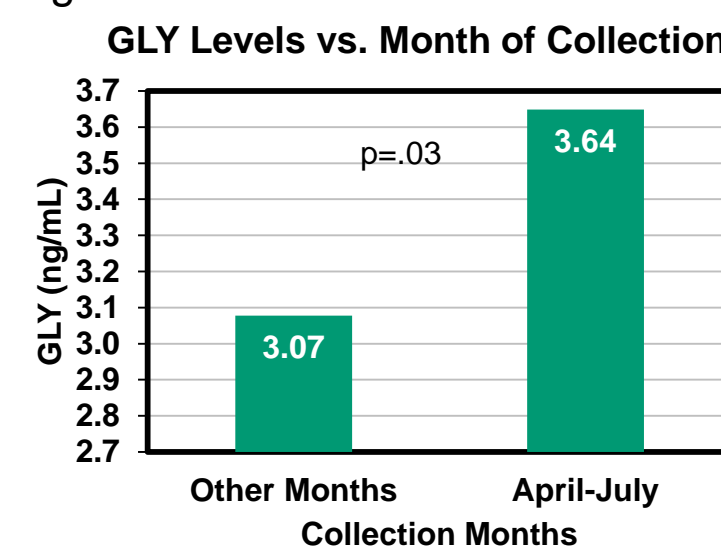


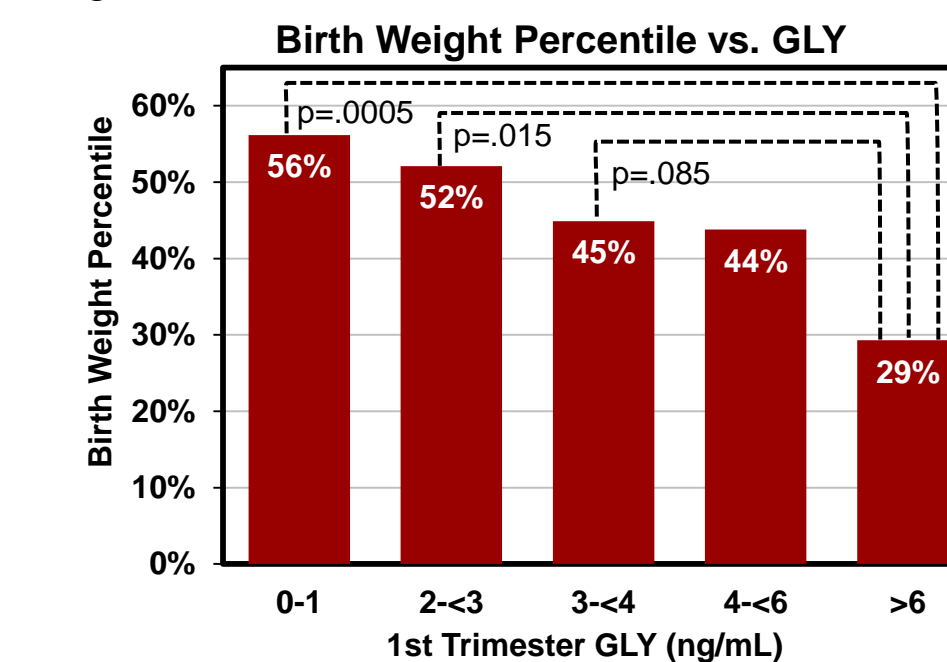
Figure 4



GLYPHOSATE VS. BIRTH WEIGHT

- 1st trimester GLY was significantly associated with decreased birth weight percentiles. Levels of >6ng/mL was associated with significantly lower birth weight percentile of 29.2 vs 56.1, (p=.0005) and 52.1 (p=.015) in women with <3ng/mL (Figure 5).

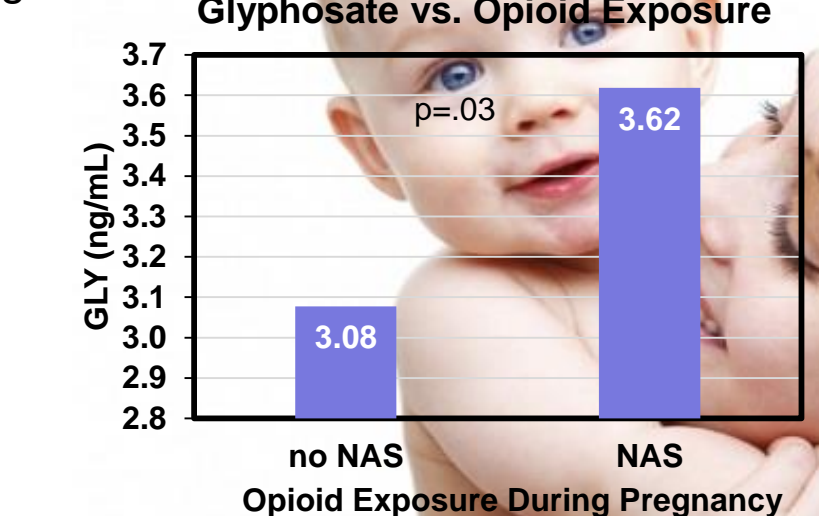
Figure 5



GLYPHOSATE VS. NAS

- Women whose infants were diagnosed with Neonatal Abstinence Syndrome had significantly higher GLY levels in the first trimester than non NAS mothers (3.62 vs. 3.08, p=.03) (Figure 9).

Figure 9



SUMMARY & CONCLUSION

- 1) Most pregnancies (in Indiana) now have detectable glyphosate levels.
- 2) GLY levels in pregnancy are increasing.
- 3) GLY levels peak in environmentally "peak" pesticide months but are likely sustained by food and beverage contamination.
- 4) Elevated GLY levels are correlated with diminished fetal growth (especially males).
- 5) Women with opioid use (as defined by NAS in offspring) had significantly higher levels of GLY in the first trimester.

Conclusion: Ubiquitous exposure to Glyphosate in pregnancy may be linked to epigenomic-mediated Transgenerational Toxicology in humans as is seen in GLY exposed pregnant rodents (2).

REFERENCE

1. S. Parvez, R. R. Gerona, C. Proctor, M. Friesen, J. L. Ashby, J. L. Reiter, Z. Lui, P. D. Winchester. 2018. Glyphosate exposure in pregnancy and shortened gestational length: a prospective Indiana birth cohort study. Environmental Health. 2018;17(23):2-12.
2. Deepika Kubsad, Eric E. Nilsson, Stephanie E. King, Ingrid Sadler-Riggelman, Daniel Beck, Michael K. Skinner. 2019. Assessment of Glyphosate Induced Epigenetic Transgenerational Inheritance of Pathologies and Sperm Epimutations. Generational Toxicology, Scientific Reports' volume 9, Article number: 6372.

GLYPHOSATE VS. ALCOHOL, MARITAL STATUS, EMPLOYMENT & EDUCATION

- Women using Alcohol had significantly lower GLY levels than non-users (Figure 6).
- Women living with their partner (unmarried) had significantly higher GLY levels than single or married women (Figure 7).
- Professional degree/employees had significantly lower GLY than women on disability (Figure 8).

Figure 6

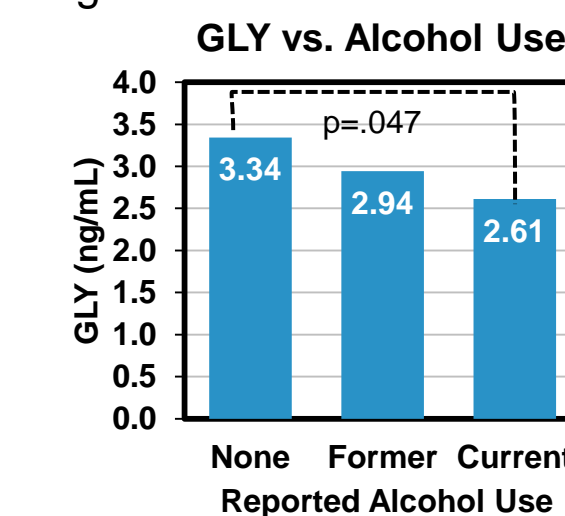


Figure 7

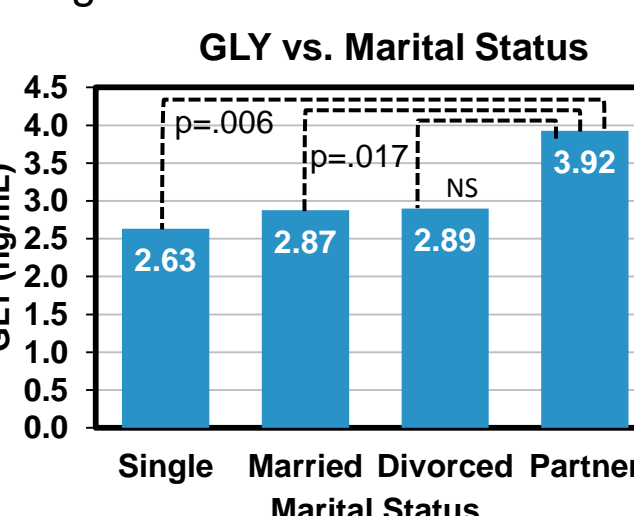


Figure 8

