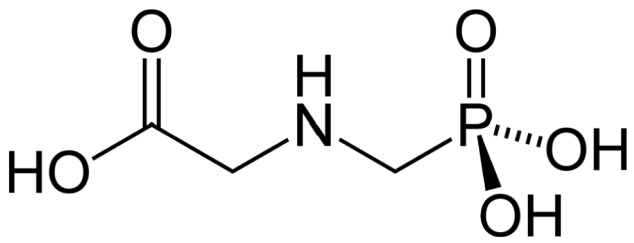
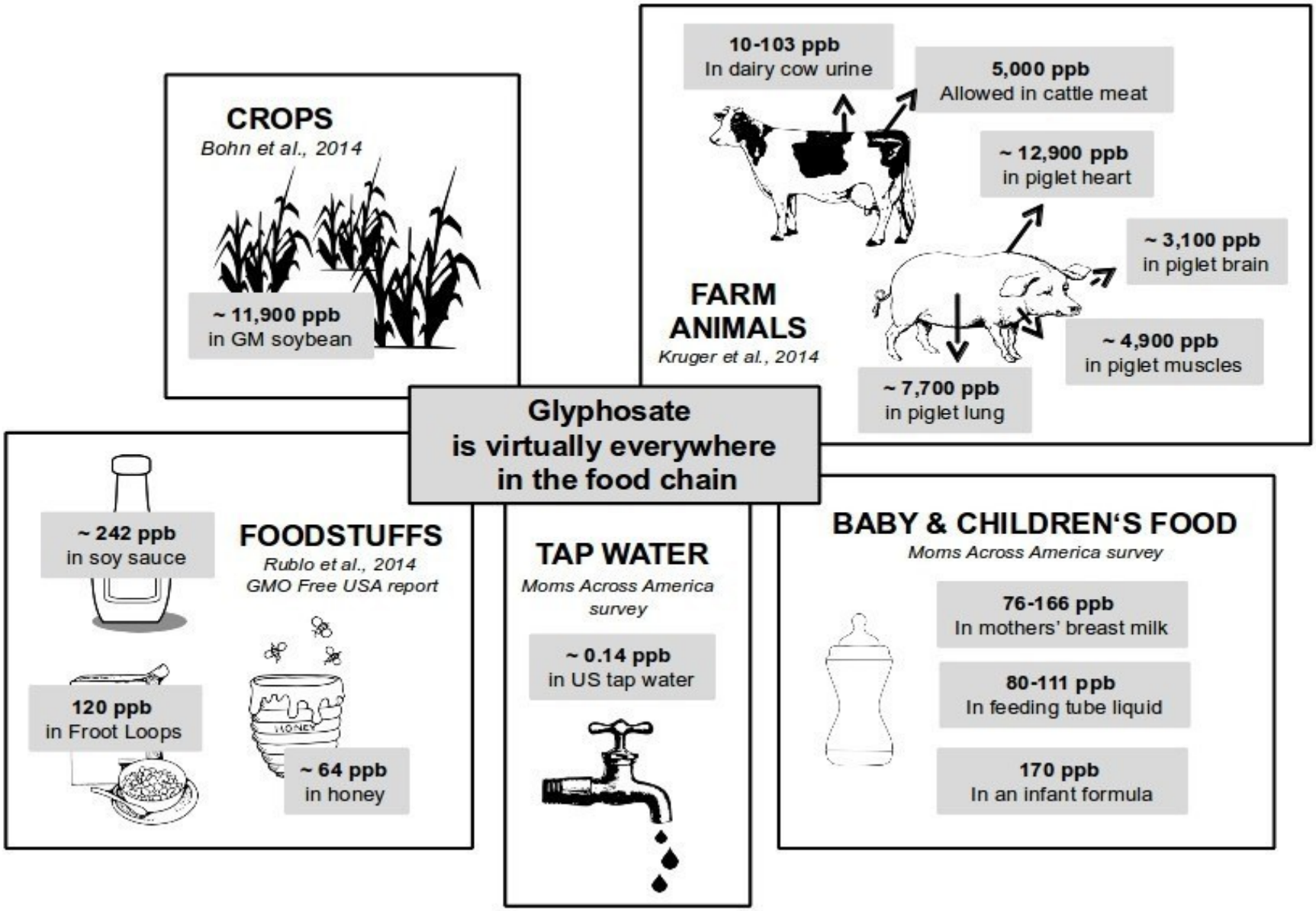
Impact of Prenatal Exposure to Glyphosate on Gestational Length and Anogenital Distance in Newborns in a Multi-center US Pregnancy Cohort



Glyphosate-based Herbicide (GBH)

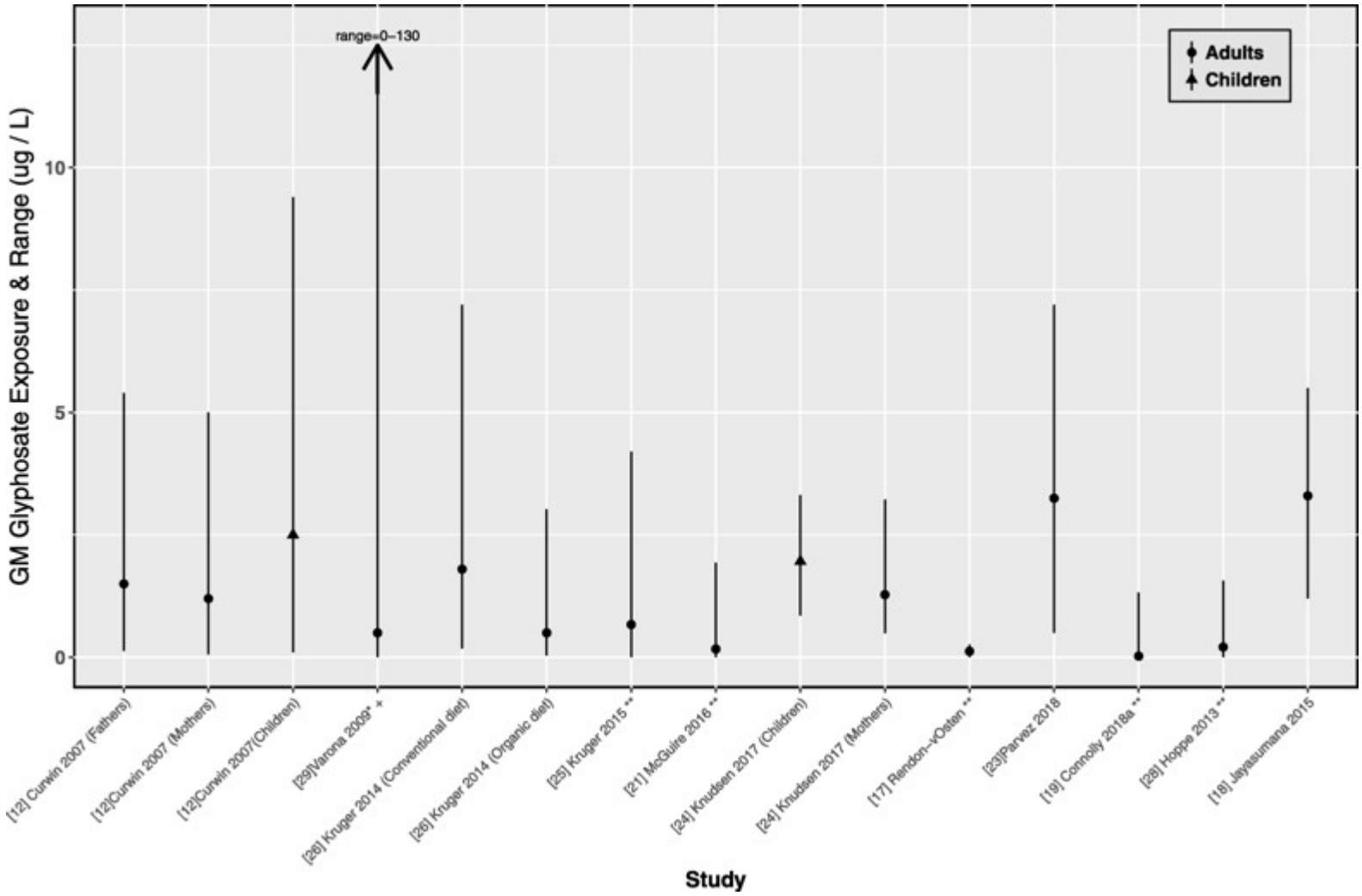
- 1950: discovered by Swiss chemist Henry Martin
- 1970: developed as herbicide and patented as Roundup® by Monsanto
- 1996: first genetically modified, glyphosate-resistant crop developed.
- 2000: out of patent
- 2015: "Probable carcinogen (2A)" by IARC
- 2018: EU renewed use of GBH for 5 years
- Currently, GBH is the most widely used herbicide in the US and the world.

Glyphosate in everywhere



https://detoxproject.org/glyphosate-in-food-water/

Glyphosate is widely dected in human urine at low levels (~ug/L)

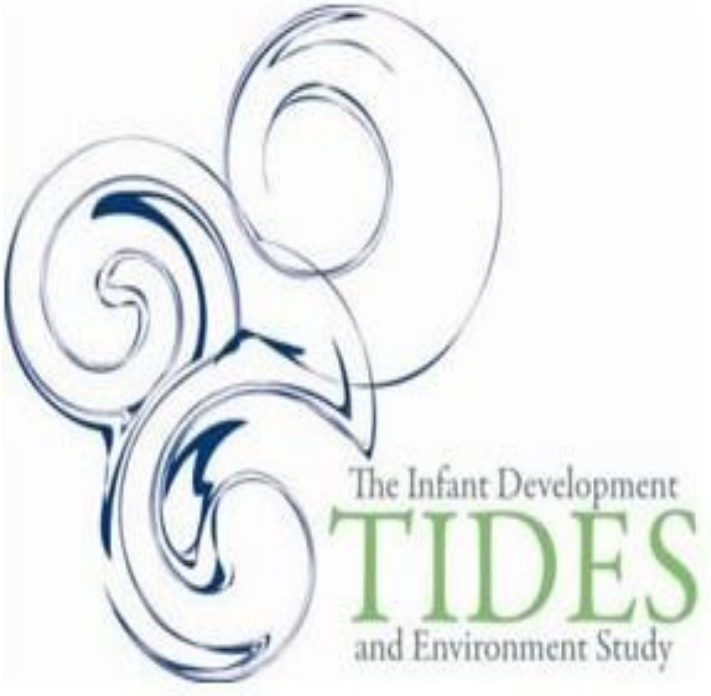


➔Gillezeau et al. Environ. Health, 2019

Knowledge Gaps

- Non-cancerous outcome
- Vulnerable populations: pregnant women, children
- In utero and early exposure
- Cross-generational effect
- Dose response

Study Population



- Designed to study how everyday chemicals in food, cosmetics, and household products may affect children's health and development.

- Multi-sites pregnancy cohort:
  - Rochester, NY,
  - Seattle, WA,
  - Minneapolis, MN
  - San Francisco, CA

- ~800 mothers enrolled at 1st trimester

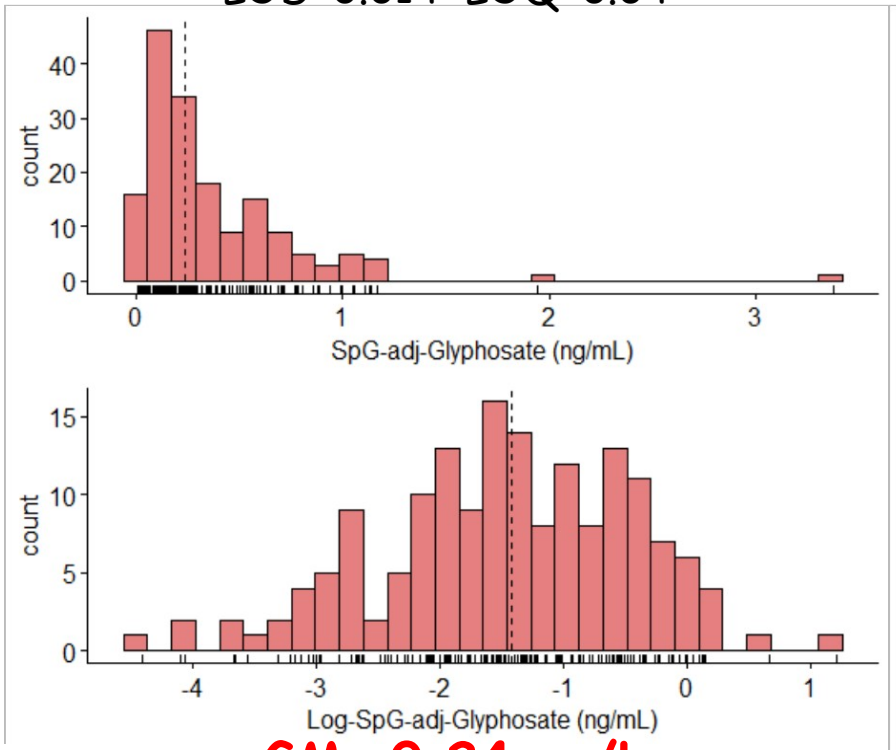
- Urine collected at each trimester, T2 used for analysis.

Study 1: Glyphosate with Gestational Length and PTB

- Preterm birth: gestational length < 37 weeks
- All PTB cases in TIDES: n=69
- Full-term control: n=94
- Spontaneous birth: n=91

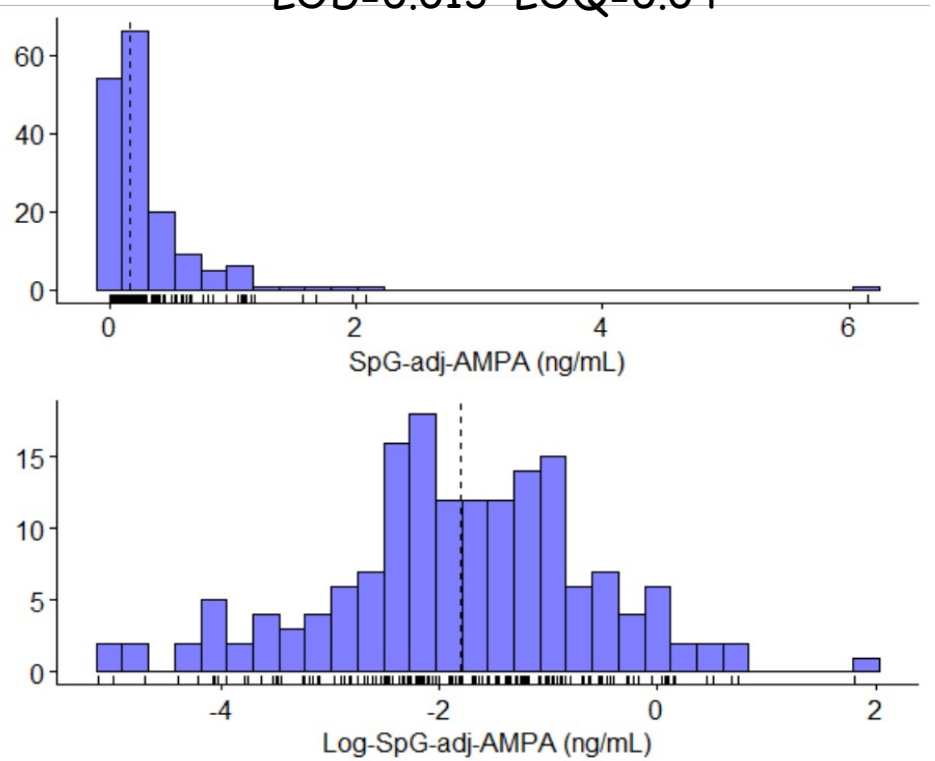
Urinary Distribution of Glyphosate and AMPA

LOD=0.014 LOQ=0.04



GM: 0.24 ug/L
96% > LOD

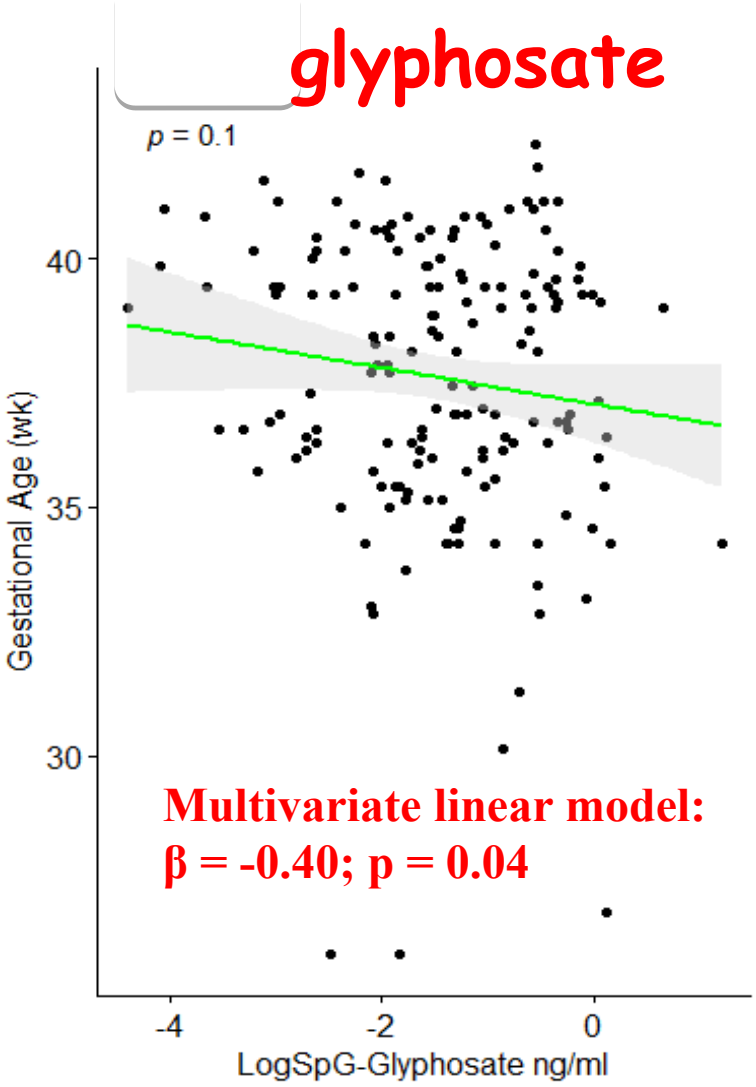
LOD=0.013 LOQ=0.04



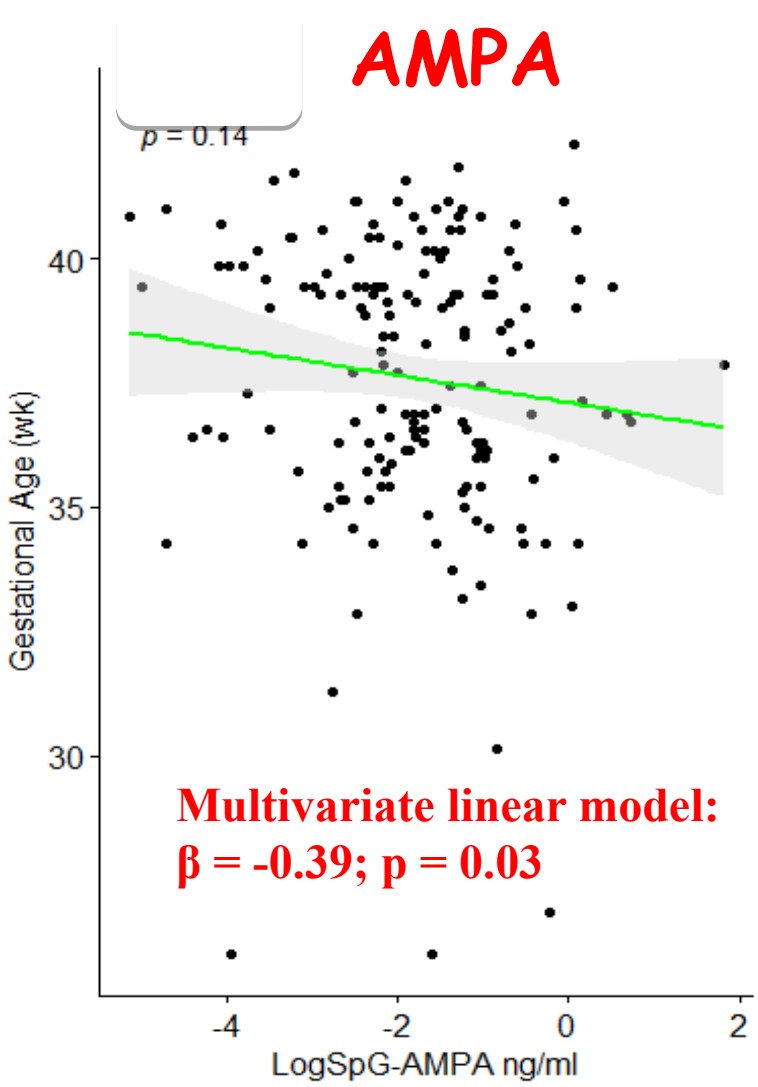
GM: 0.17 ug/L
94% > LOD

GM: 0.24 ug/L = 0.16% ADI, Max: 3.6 ug/L = 2.3% ADI

Inverse association with gestational length
(69 PTB and 97 term births)

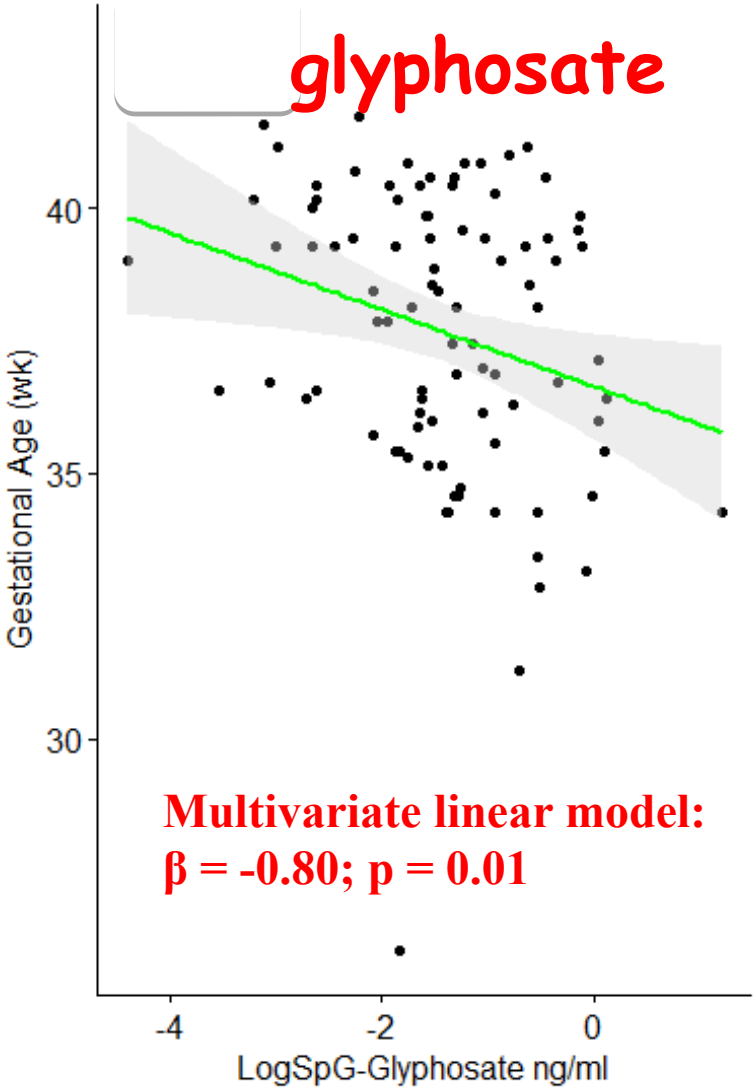


Multivariate linear model:
β = -0.40; p = 0.04

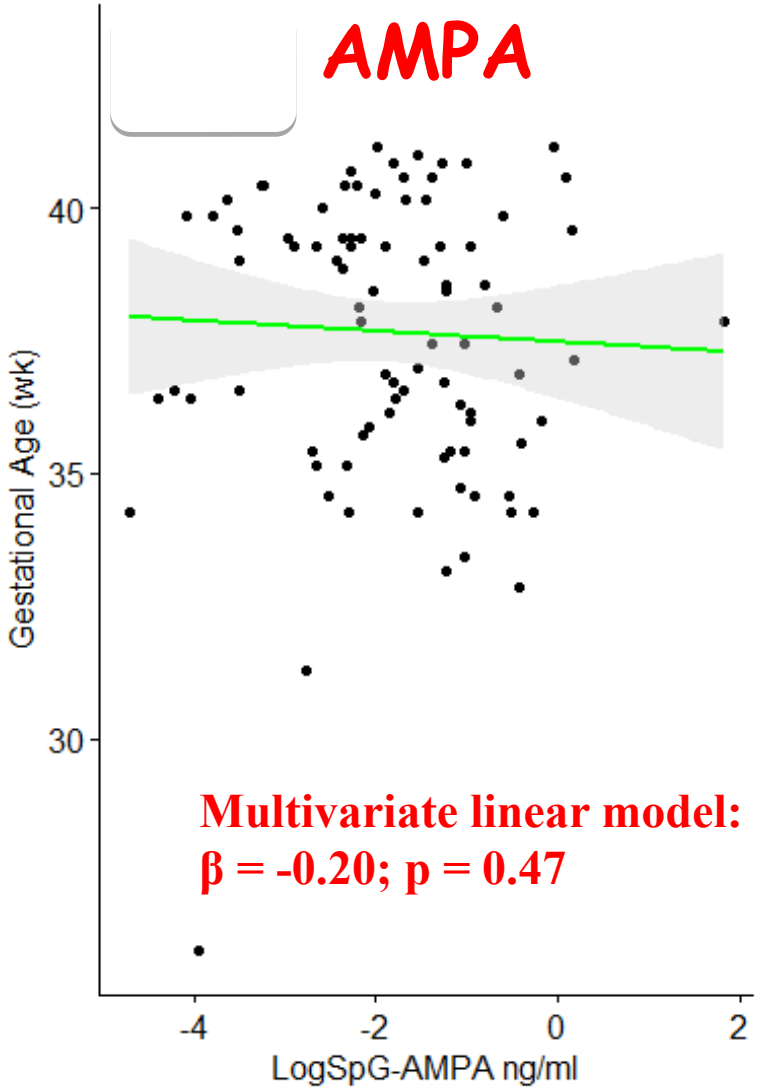


Multivariate linear model:
β = -0.39; p = 0.03

Inverse association and gestational length
(91 spontaneous birth)



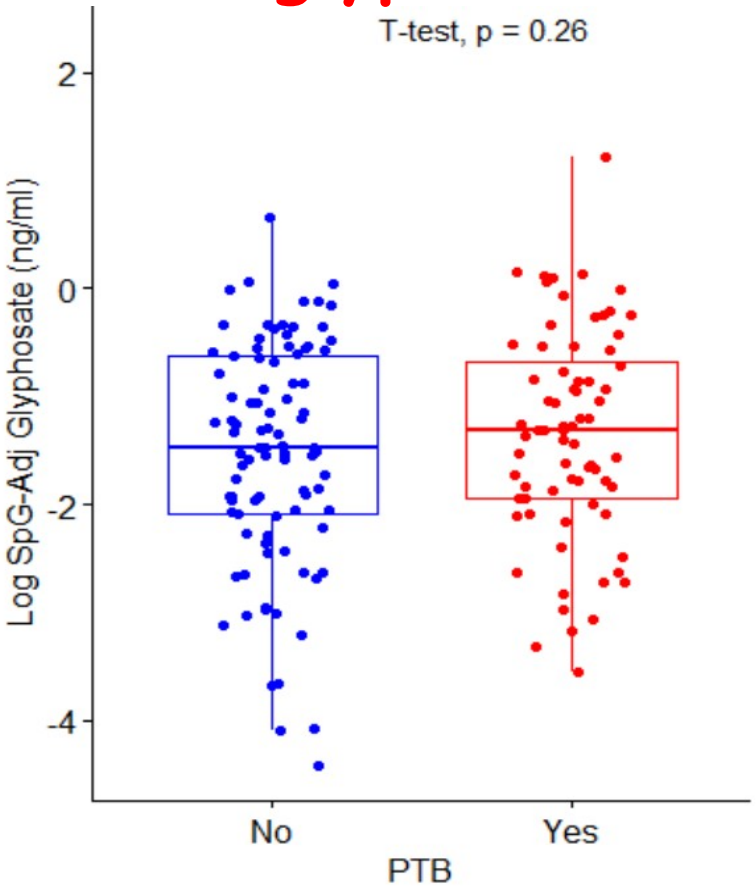
Multivariate linear model:
β = -0.80; p = 0.01



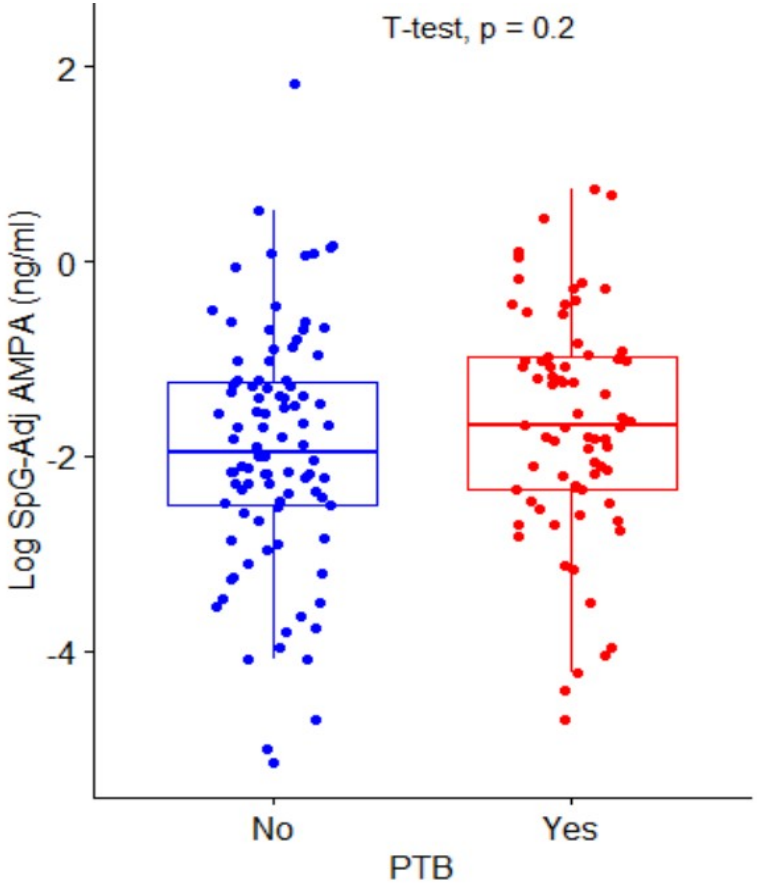
Multivariate linear model:
β = -0.20; p = 0.47

Glyphosate/AMPA and PTB

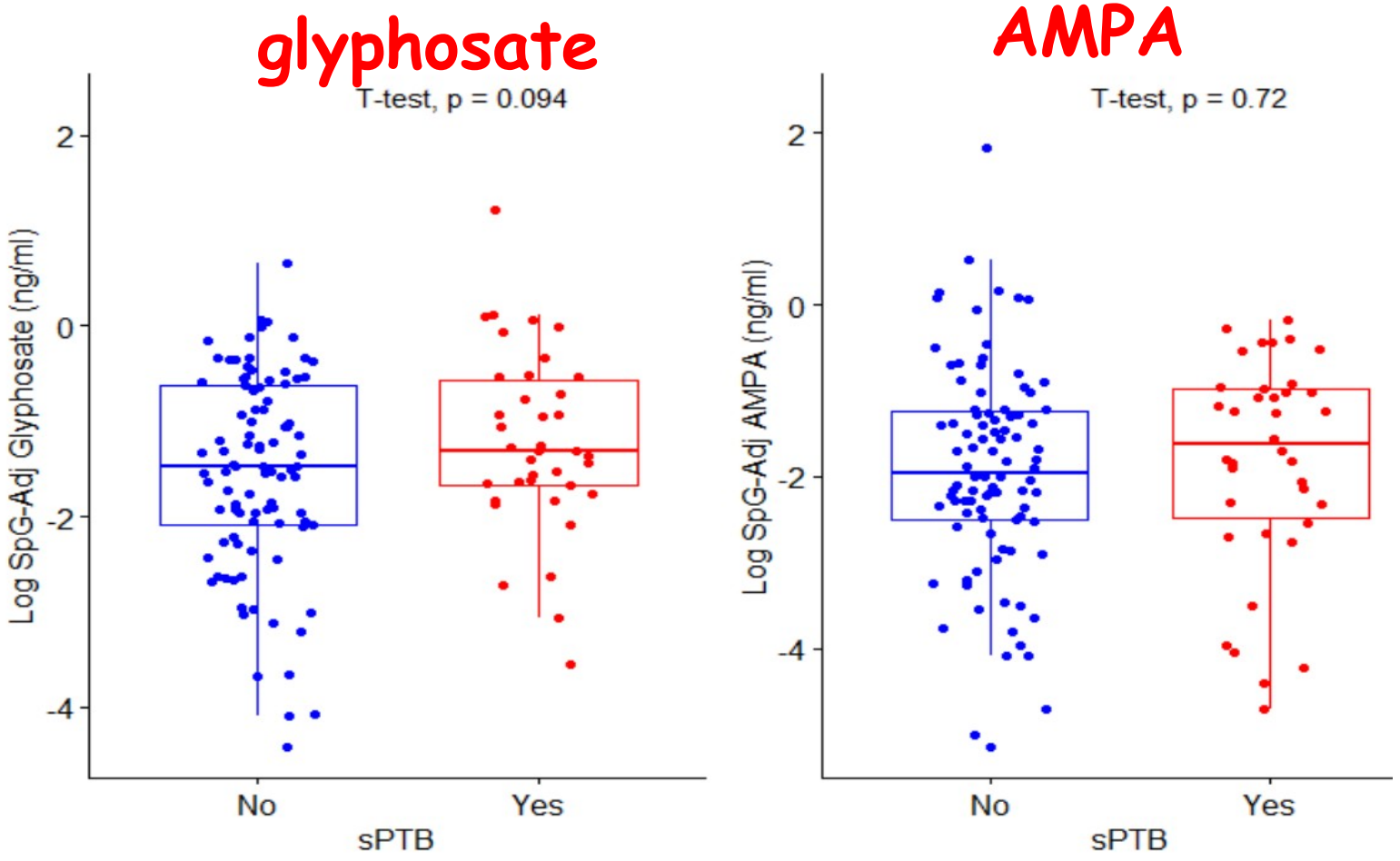
glyphosate



AMPA

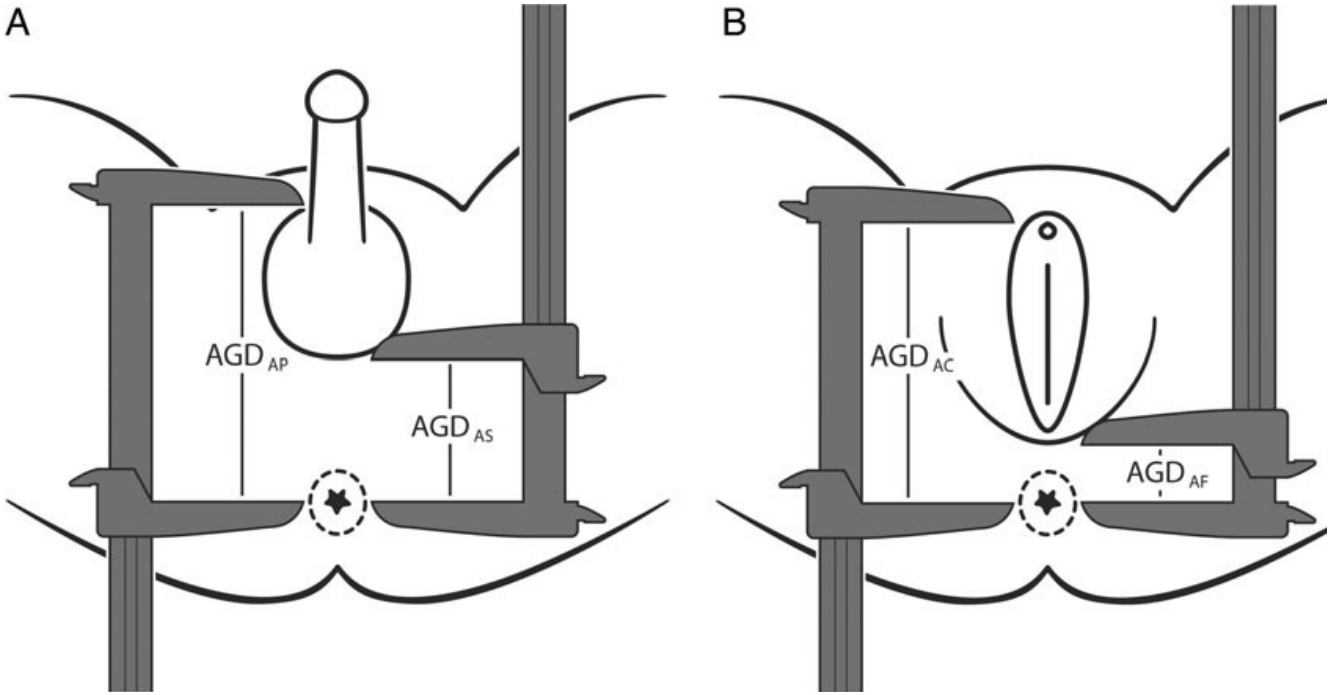


Glyphosate/AMPA and sPTB

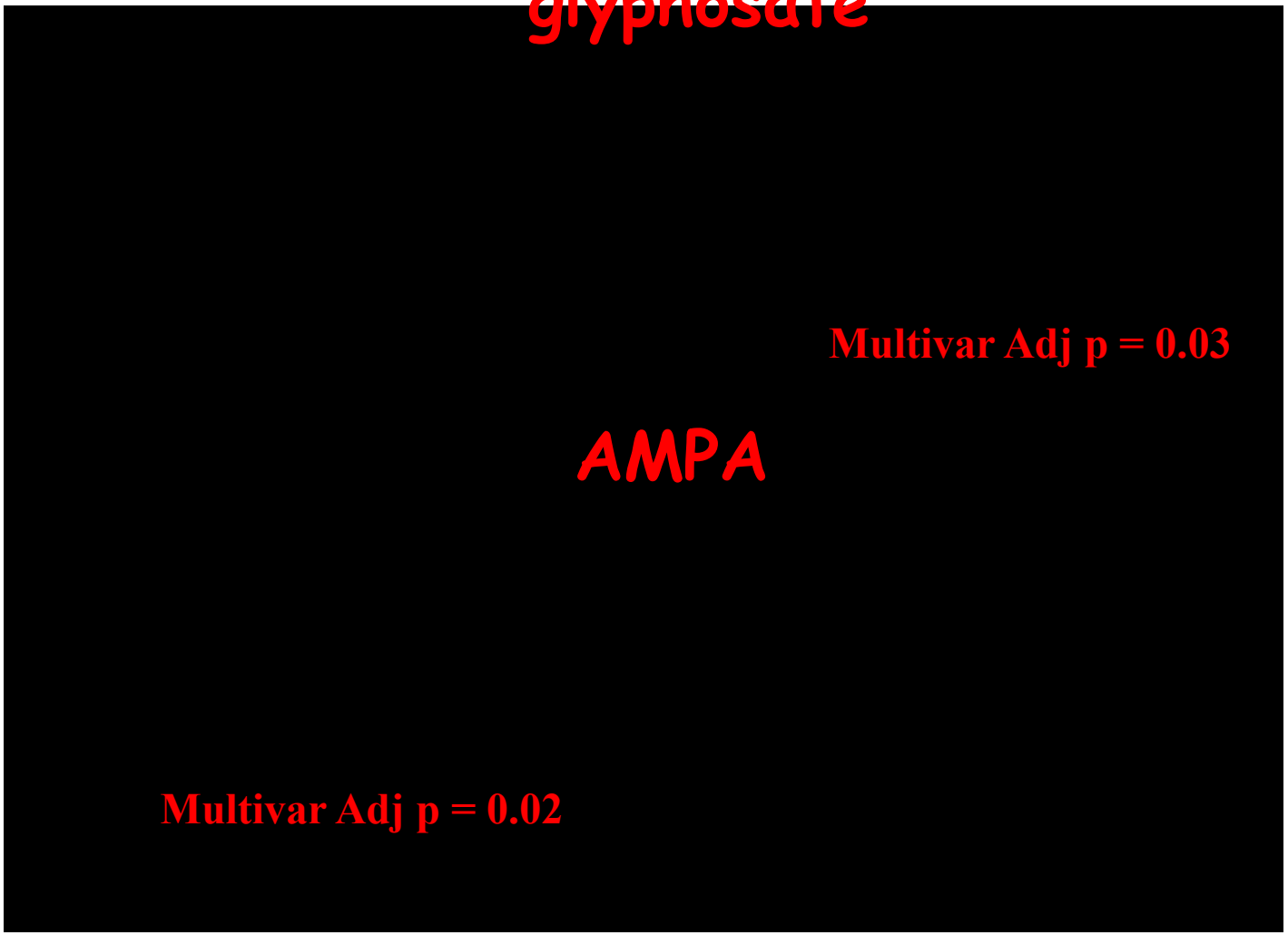


Anogenital Distance (AGD)

- an early-life biomarker of fetal androgen exposure
- reproductive toxicity endpoint by the US EPA
- 100 (50F:50M) random term babies

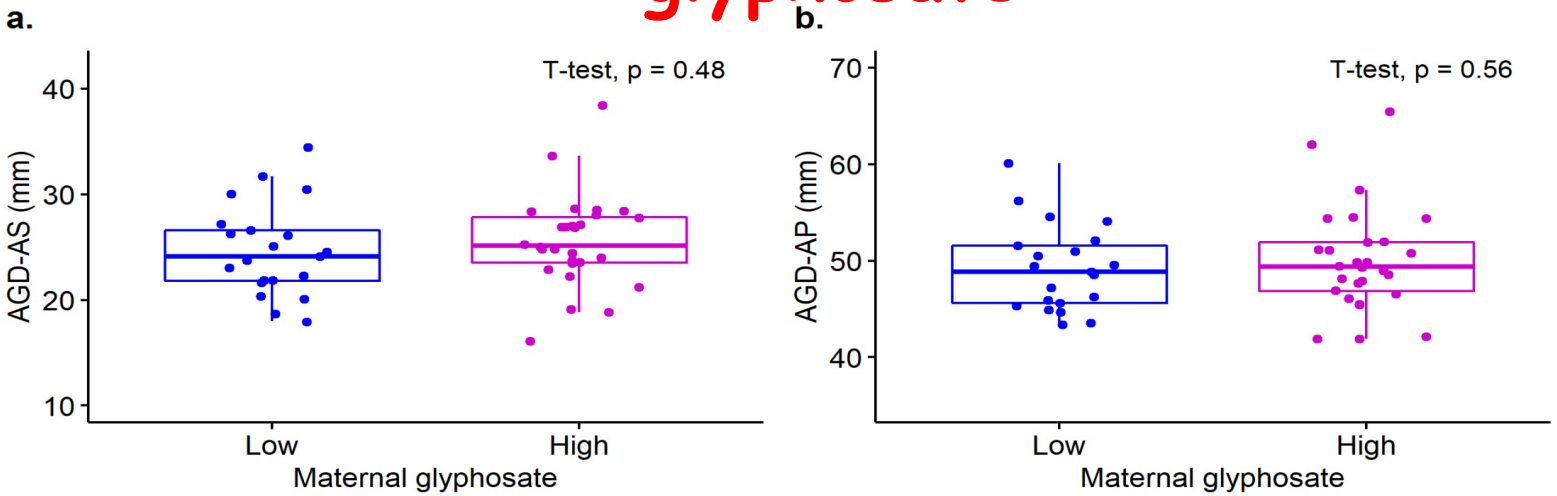


Glyphosate/AMP and AGD (females)

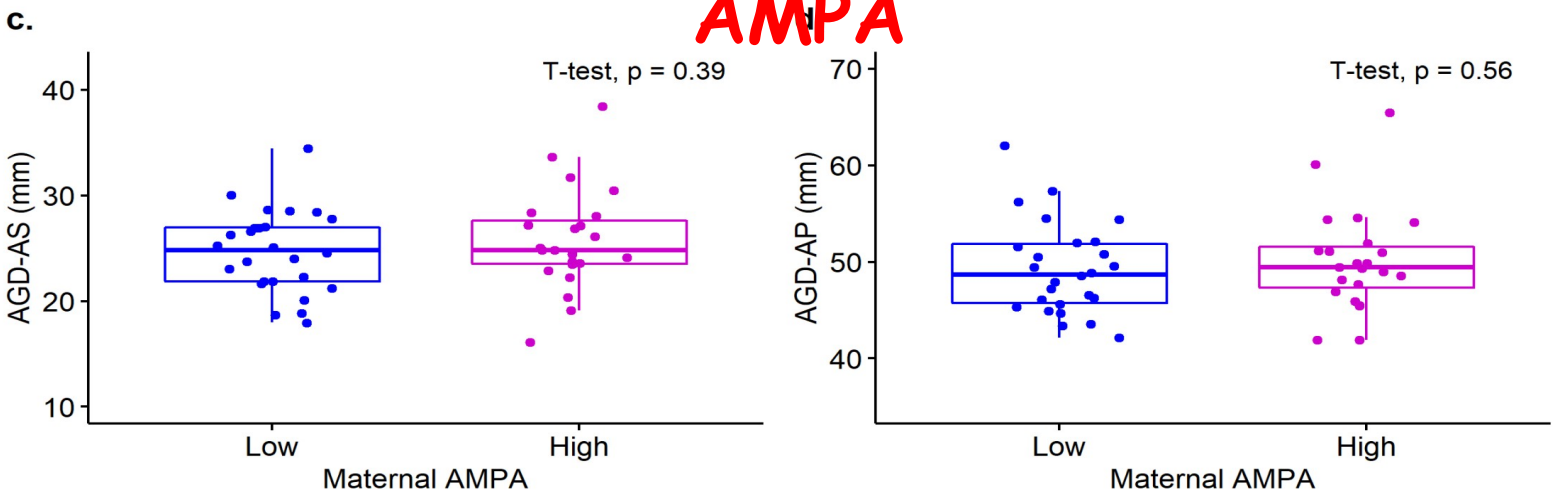


Glyphosate/AMP and AGD (Males)

glyphosate



AMPA



Conclusions

- Exposure to glyphosate is ubiquitous in general public
- External dose is low – an magnitude lower than ADI (assuming the correct model is correct).
- Urinary levels of glyphosate and AMPA are inversely associated with gestational length but less so with PTB (low power)
- Urinary levels of glyphosate and AMPA are positively associated with AGD in females only.
- Reproductive toxicity and endocrine disrupting property of glyphosate needs to be evaluated at human level doses.
- Additives in GBHs needs to be evaluated.

Thank you!

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