The contribution of diet to pesticide exposure in pregnant women and children

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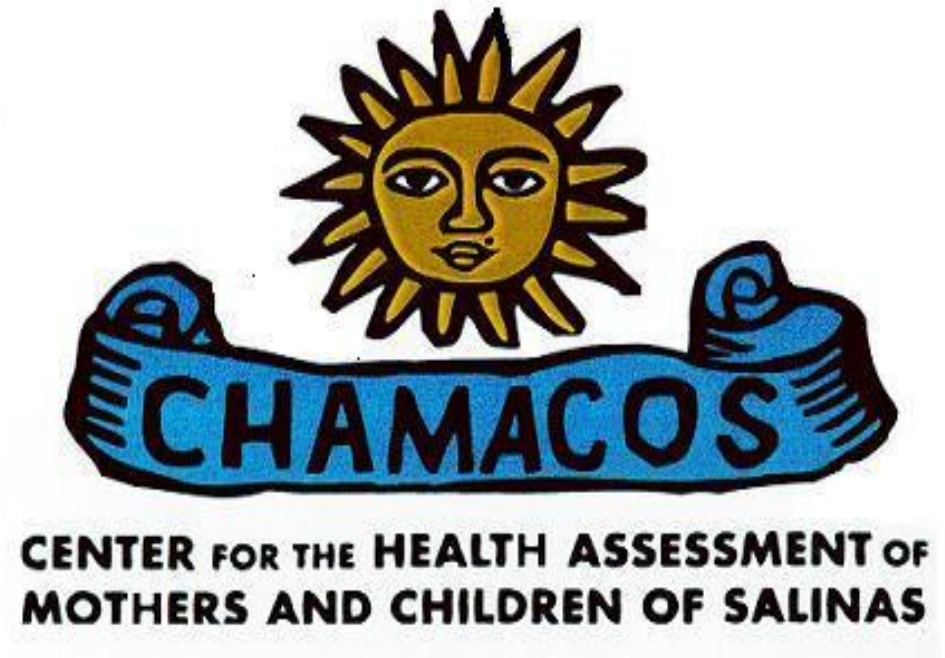
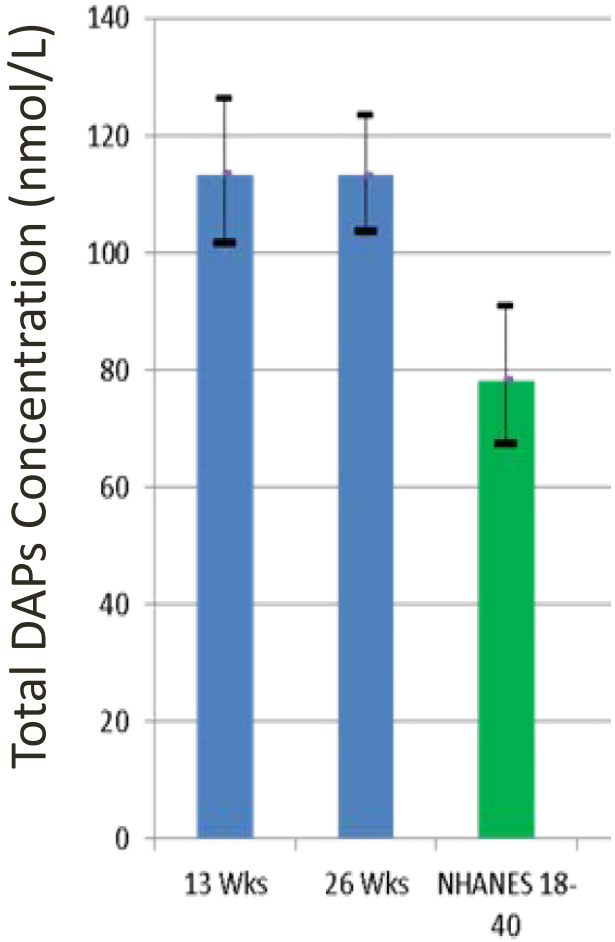
EPA/NIEHS Webinar, Dec 9, 2015

Center for the Health Assessment of Mothers and Children of Salinas



A birth cohort study investigating the health effects of environmental exposures in low income Mexican-American children living in an agricultural community.

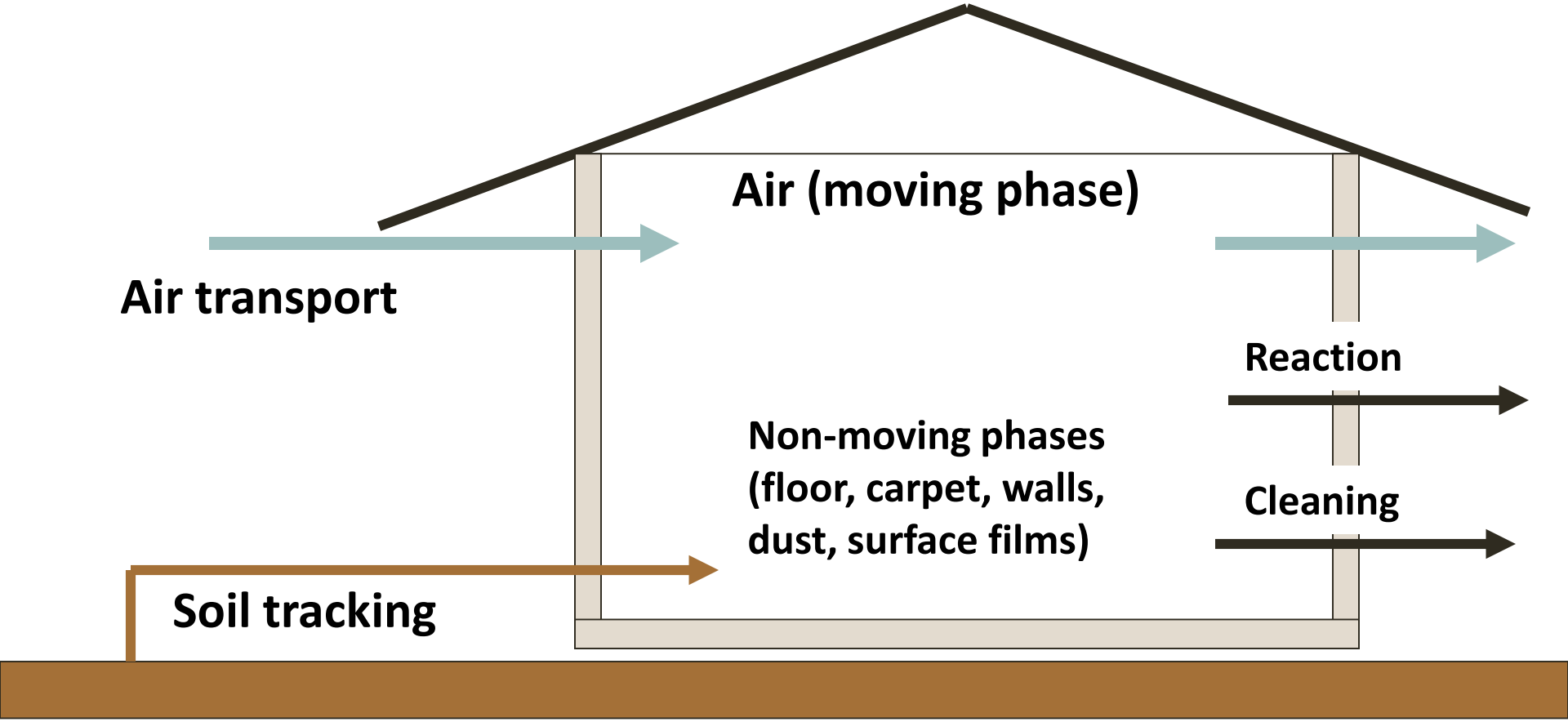
CHAMACOS mothers' OP metabolite levels are higher than US averages (NHANES)



Bradman et al. EHP, 2005,

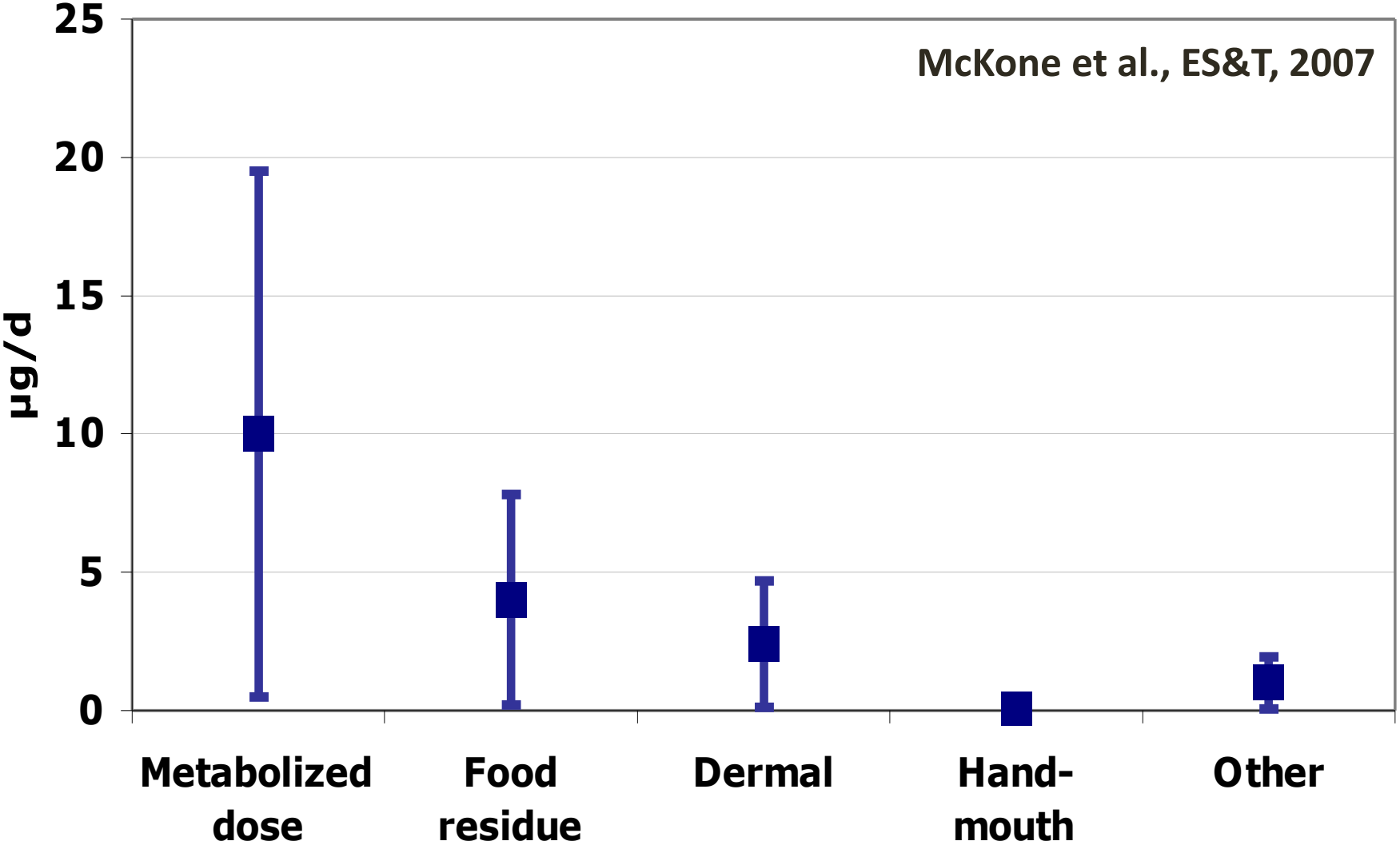
Source: www.ucl.ac.uk

We modeled exposure to the mom's:

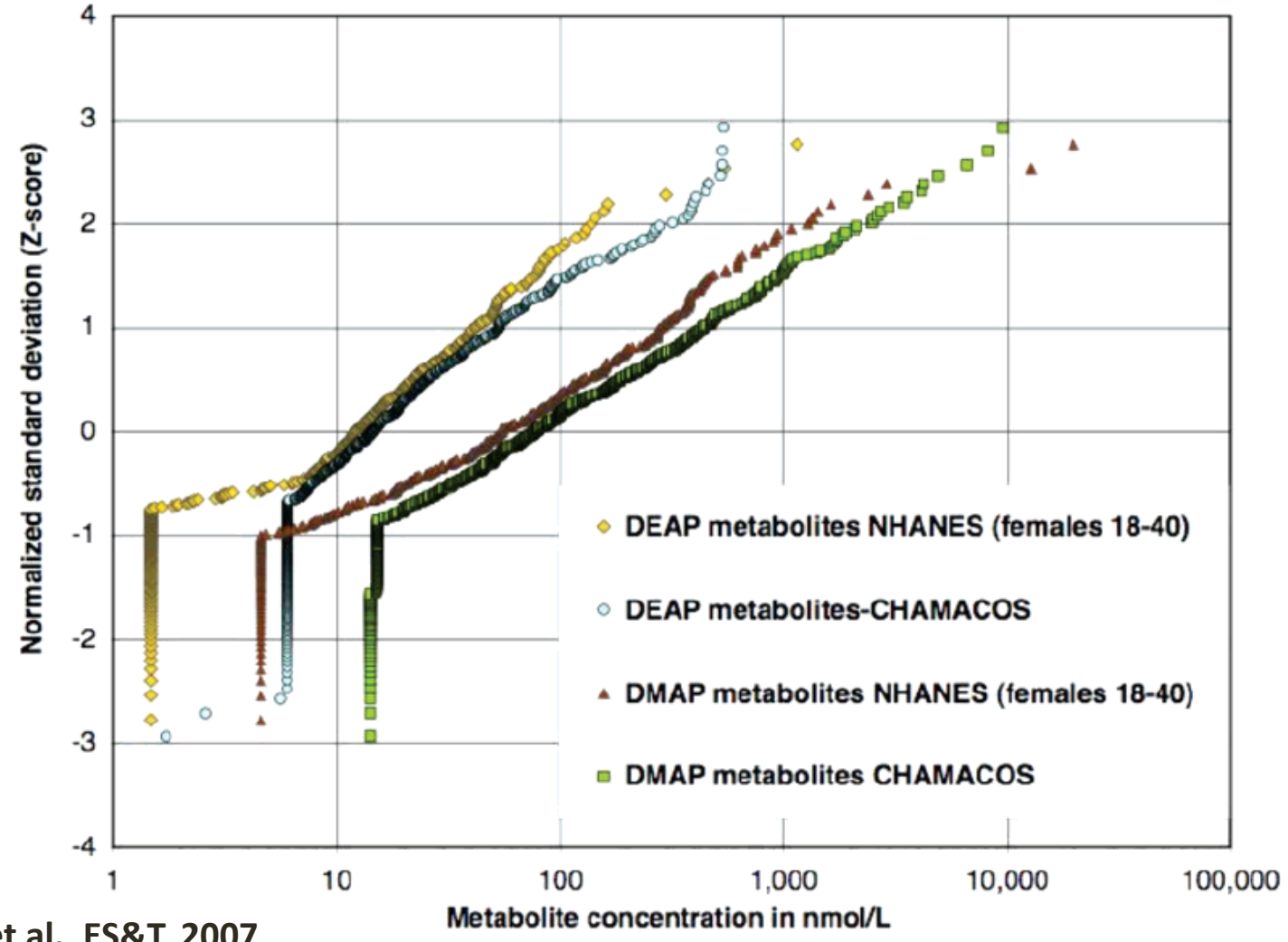


McKone et al., ES&T, 2007

Estimated maternal chlorpyrifos dose vs. modeled sources

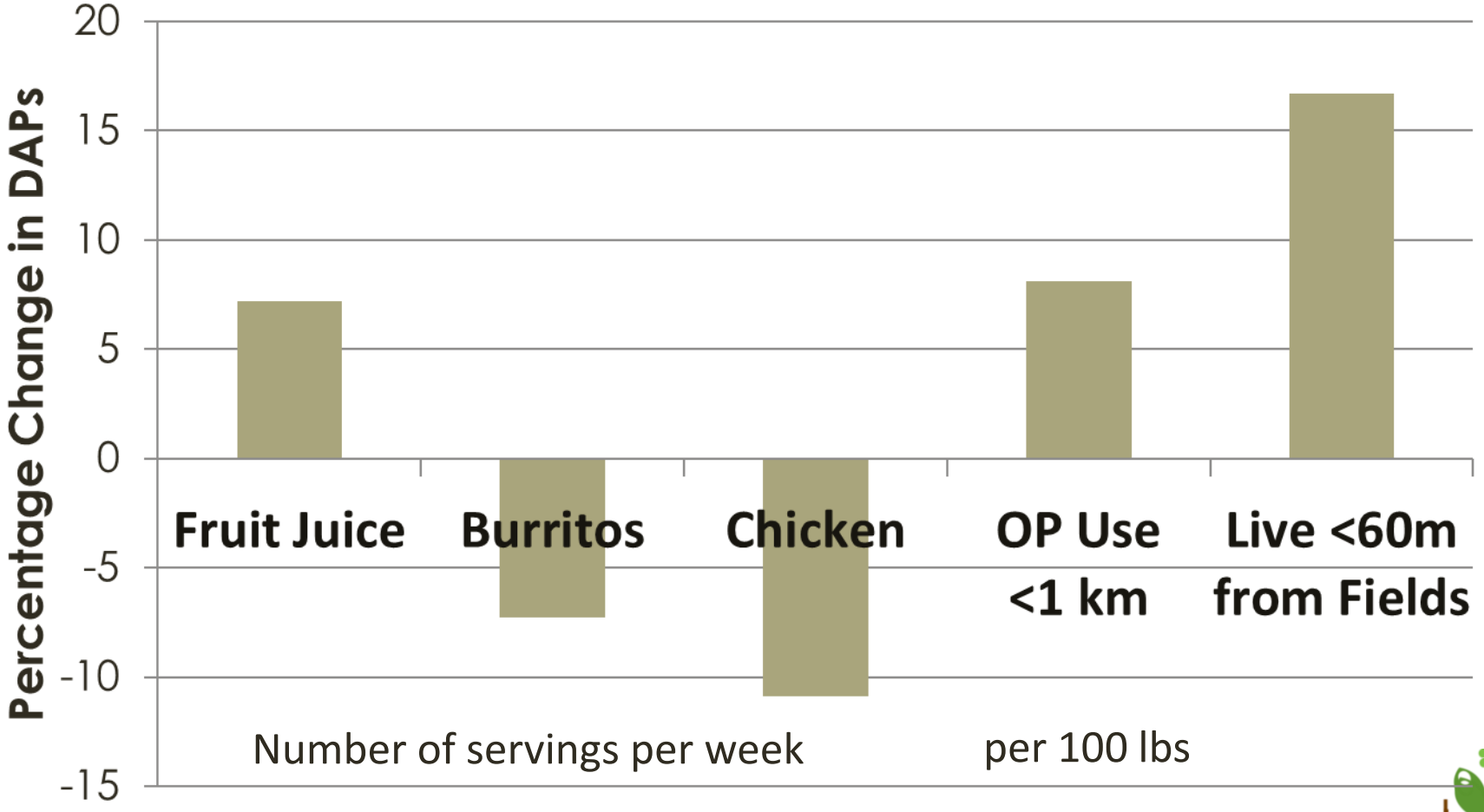


Cumulative Distributions of DAPs in CHAMACOS Mothers and NHANES Women

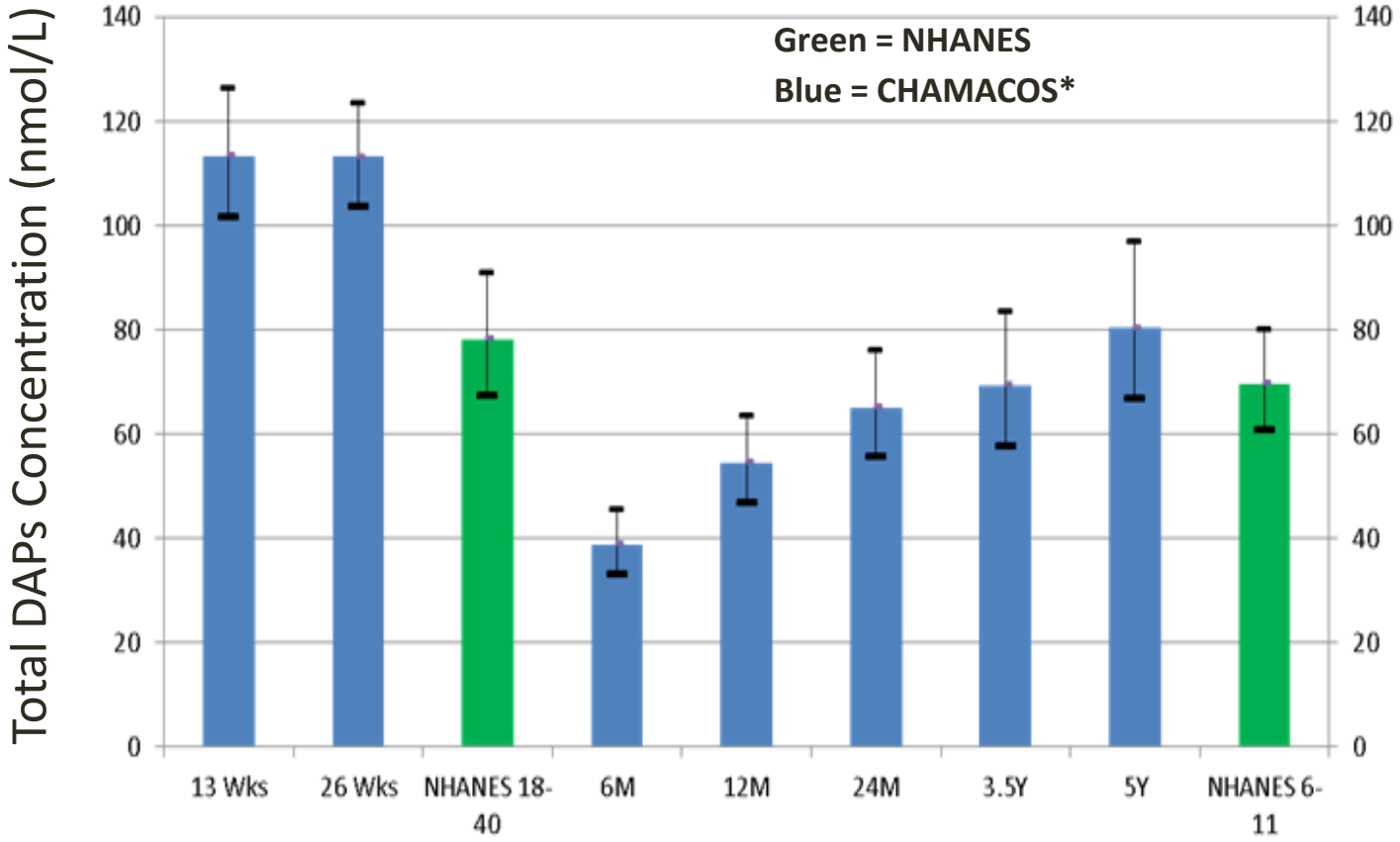


McKone et al., ES&T, 2007

Determinants of Maternal DAPs



CHAMACOS children's OP metabolite levels are higher than US averages (NHANES)



*13 and 26 week levels from mothers; all others from children

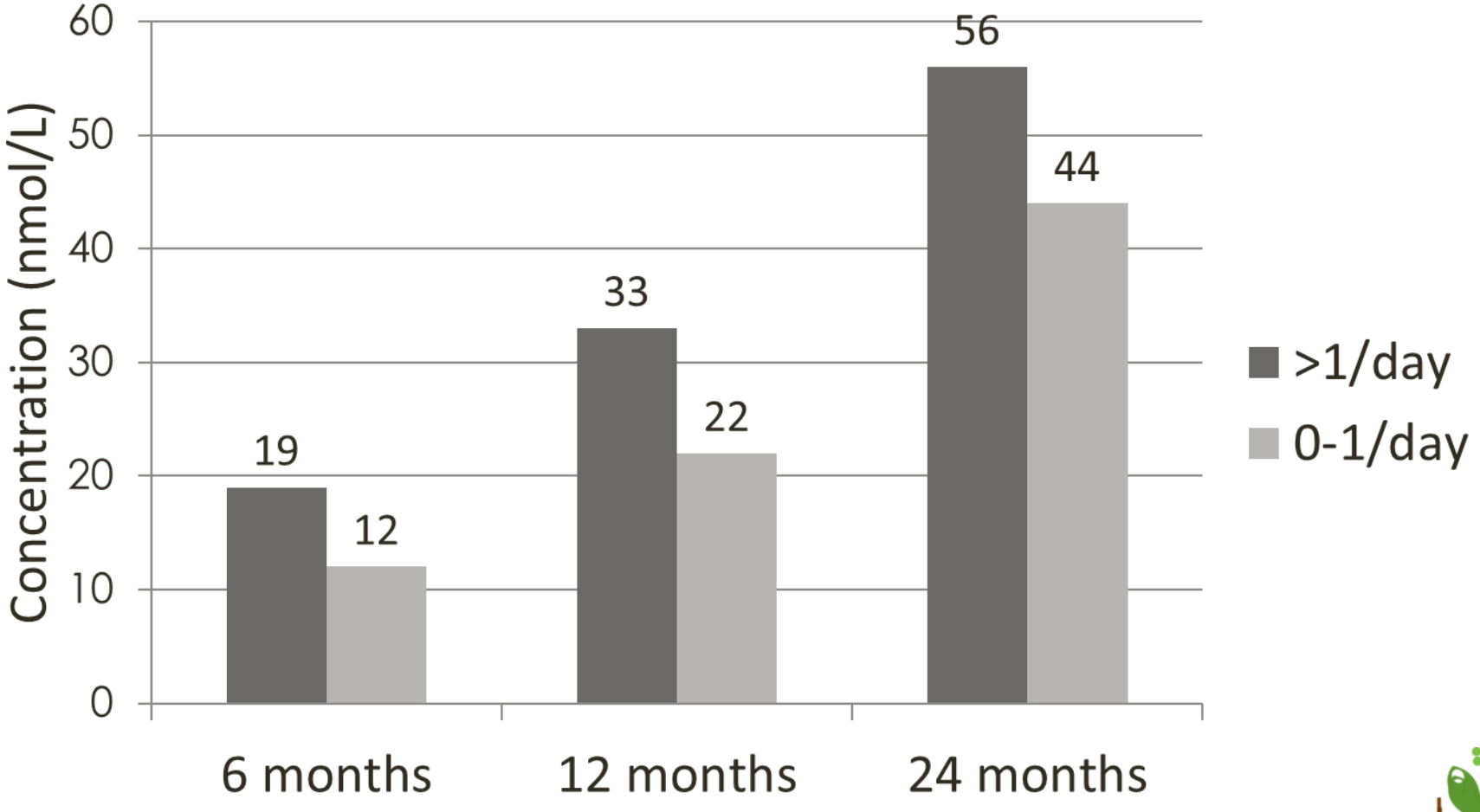
Bradman et al. EHP, 2005, 2011

Pesticides in breast milk

Overall (N=93)		DF
Organophosphates		
	Chlorpyrifos*	97%
	Chlorpyrifos-methyl	56%
	Fonofos	12%
	Phosmet	10%
	Disulfoton	9%
	Diazinon	1%
Pyrethroids		
	cis-Permethrin	100%
	trans-Permethrin	100%
	Cyfluthrin	22%
	Cypermethrin	12%
	Deltamethrin	6%
Other		
	Propoxur	26%
	Bendiocarb	4%
	Atrazine	23%

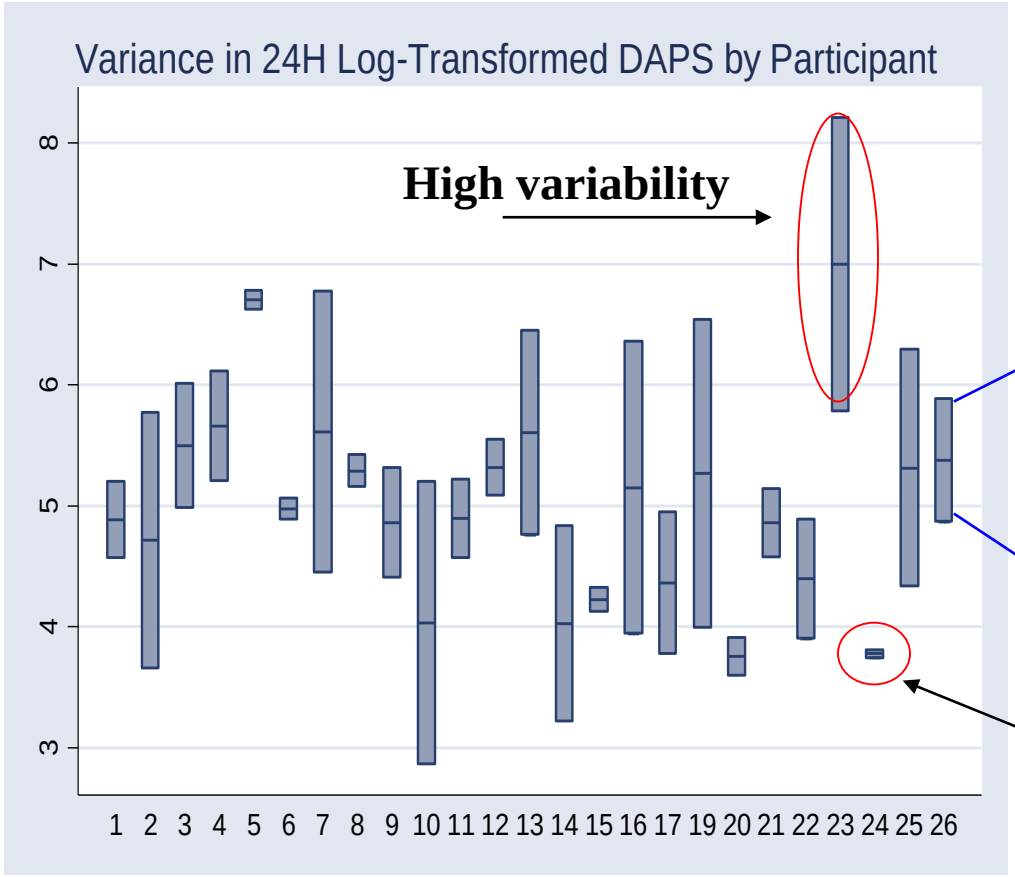
Weldon et al., JEM, 2011

Median DM metabolite levels by fruit and vegetable consumption



Bradman et al., IJERPH, 2011

Metabolites in 24 hr urine samples collected 3 days apart (n=25 pairs).

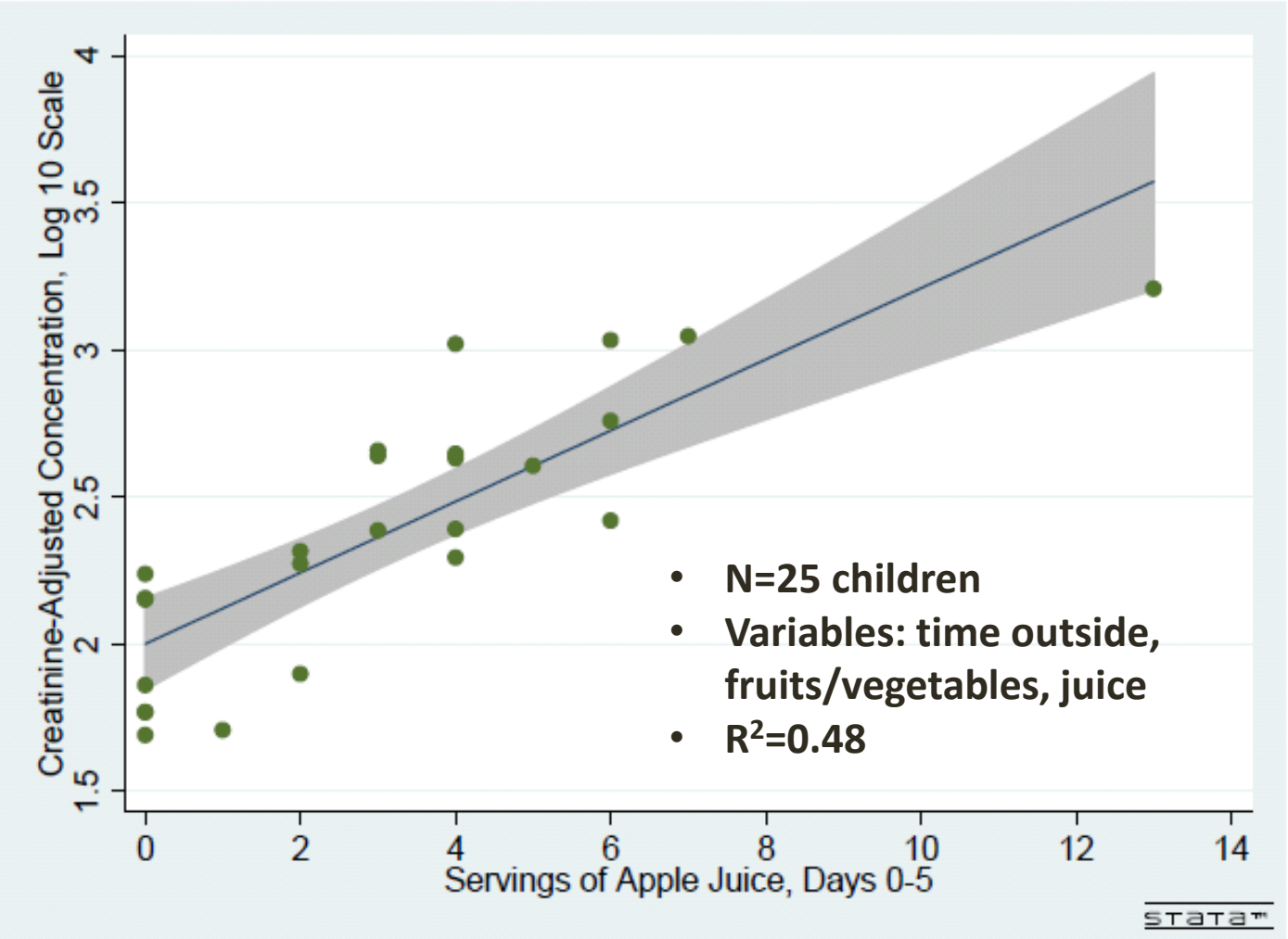


Estimated within and between variability (SD)

Between	**31%**
Within	**69%**

Bradman and Kogut et al., 2012, EHP.

Juice appears to be a major source of OP pesticide metabolites



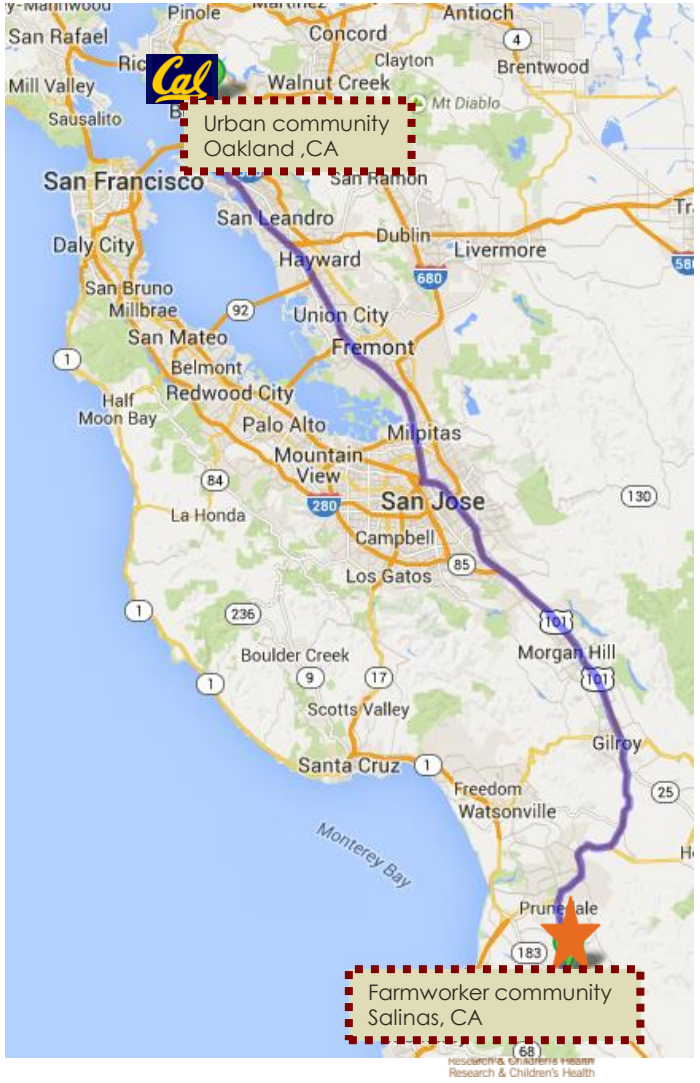
Bradman et al., unpublished

Organic Diet Study – Research Questions

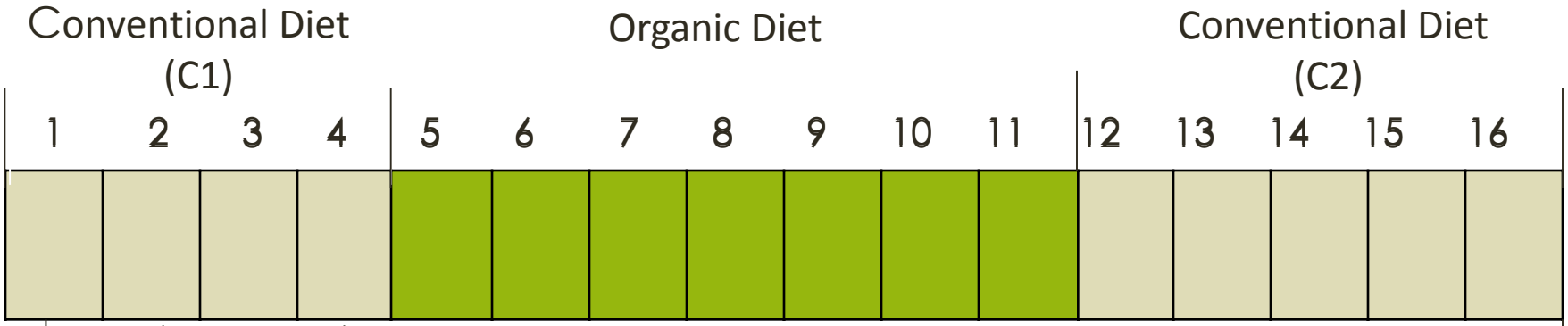
- Does an organic diet reduce pesticide exposure among low-income children?
- Does the estimated impact of an organic diet differ between low-income children living in urban and agricultural communities?

Study Population (N=40)

- Convenience sample:
  20 urban children (Oakland, CA)
  20 farmworker children (Salinas, CA)
- 3-6 year old boys and girls
- Farmworker parent (Salinas, CA)
- Mexican-American/Mexican immigrants
- Low-income (65% ≤ poverty threshold)
- Jun-Sept 2006



Study Design & Sample Collection



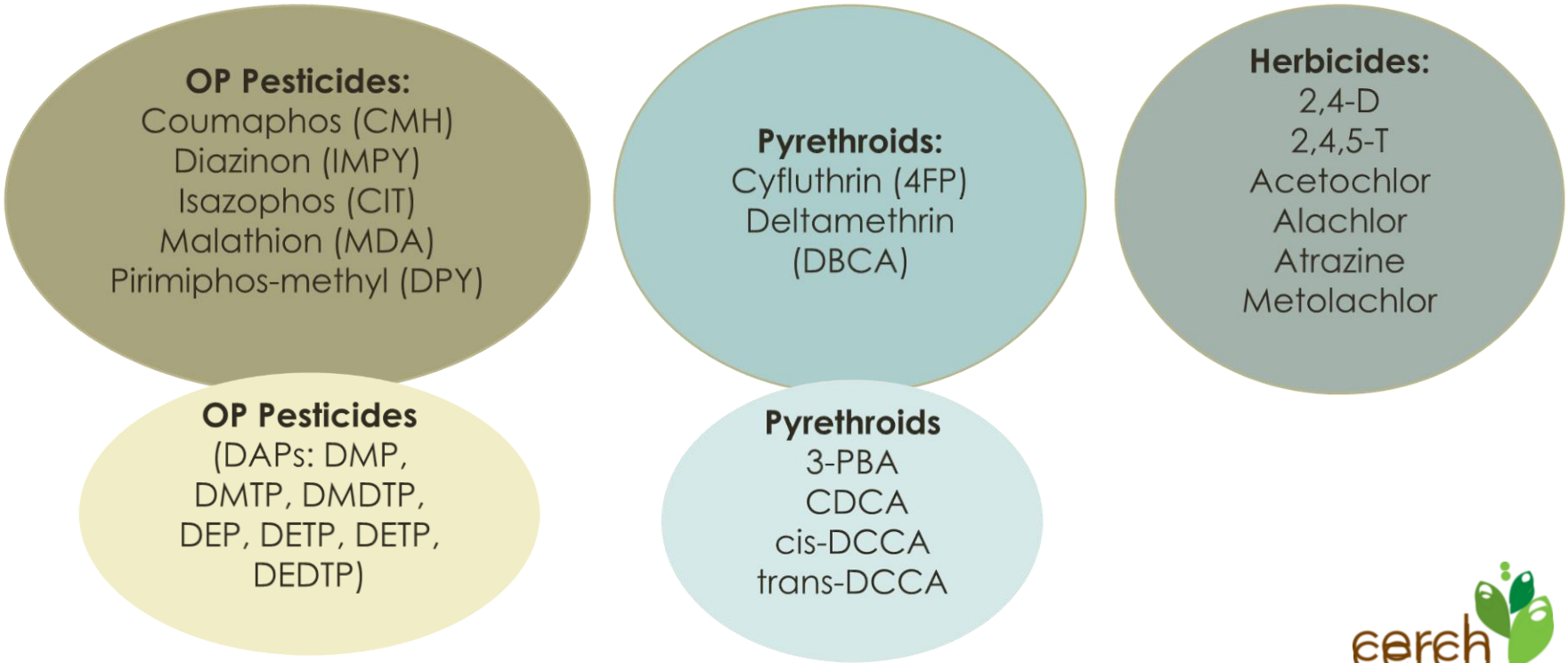
Day 4:
- Delivery of organic food

Days 2-16:
- Urine Sample (FMV)
- Daily interviews
- Food diaries

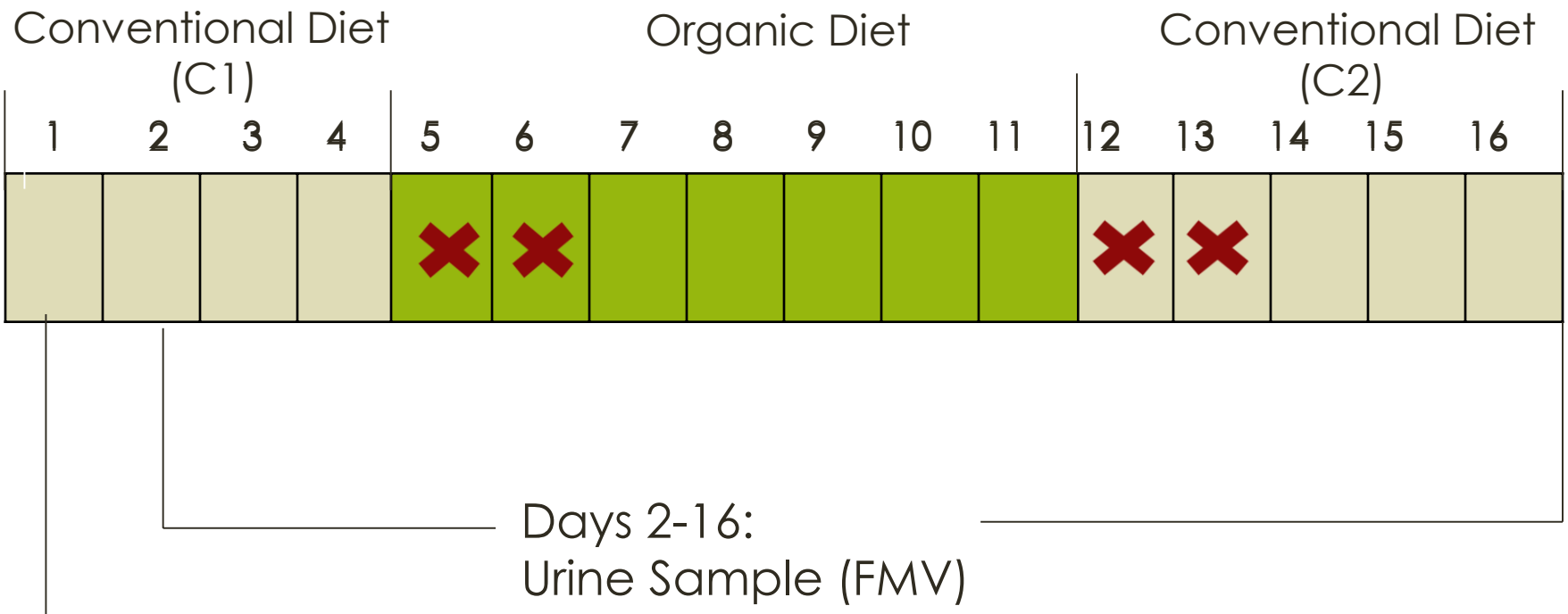
Day 1: Consent, main questionnaire, home inspection, trained parents on urine sample collection

Exposure Assessment

- Measured 23 metabolites reflecting potential exposure to pesticides used indoors and/or in agriculture. Analysis done by CDC.



Washout days excluded from analyses



✖ Washout Days (**excluded from analyses**)

Other exclusions and statistical analyses

- Parent-reported that child did not follow diet protocol
- Reported pesticide use during the study period (only those relevant samples for relevant metabolites)
- Adjusted linear–mixed effects models to estimate the effect of diet on urine metabolite concentrations (% change); interaction term (loc x diet; $p<0.20$)
- C1 and C2 were combined; no significant difference in metabolite levels between these phases

Non-specific OPs, pyrethroids, and two herbicides were commonly detected

Specific Metabolites

OP Pesticides:
Coumaphos (CMH)
Diazinon (IMPY)
Isazophos (CIT)
Malathion (MDA)
Pirimiphos-methyl (DPY)

Pyrethroids:
Cyfluthrin (4FP)
Deltamethrin
(DBCA)

Herbicides:
2,4-D
2,4,5-T
Acetochlor
Alachlor
Atrazine
Metolachlor

Non-specific Metabolites

OP Pesticides
(DAPs: DMP, DMTP, DMDTP, DEP, DETP, DETP, DEDTP)

Total DEs, DMs, DAPS

Pyrethroids
3-PBA
CDCA
cis-DCCA
trans-DCCA

3-PBA

2,4-D, MET

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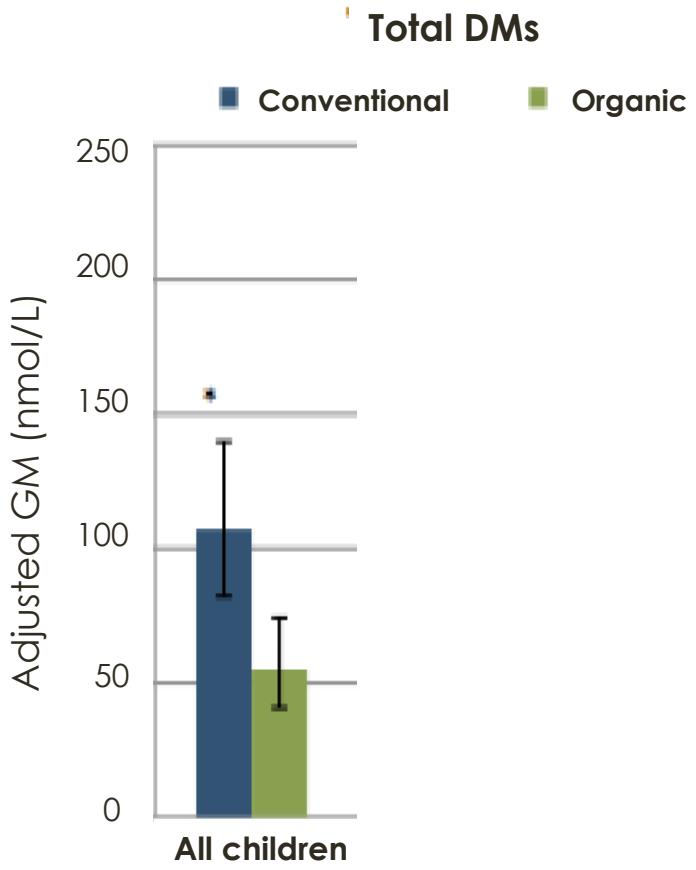
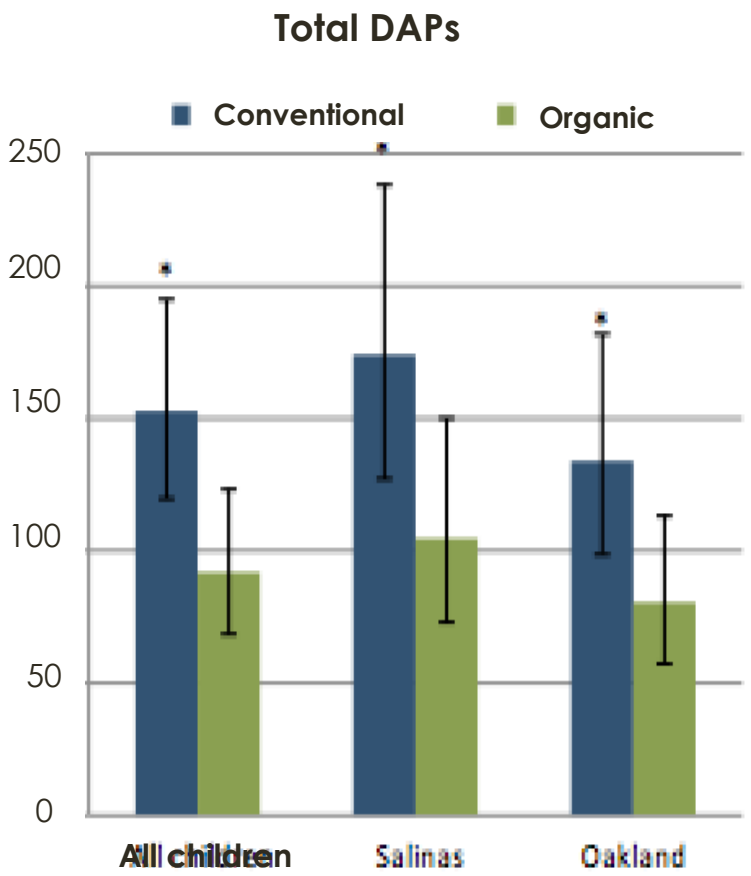
Total DMs/DAPs: Significant decrease in levels during the organic diet for ALL children

-49%

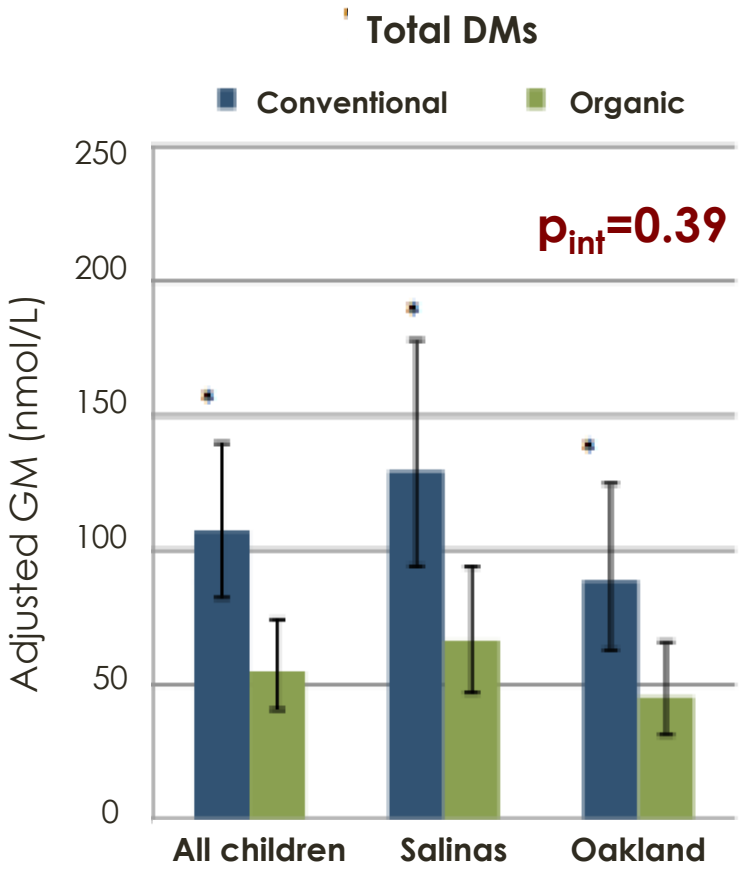


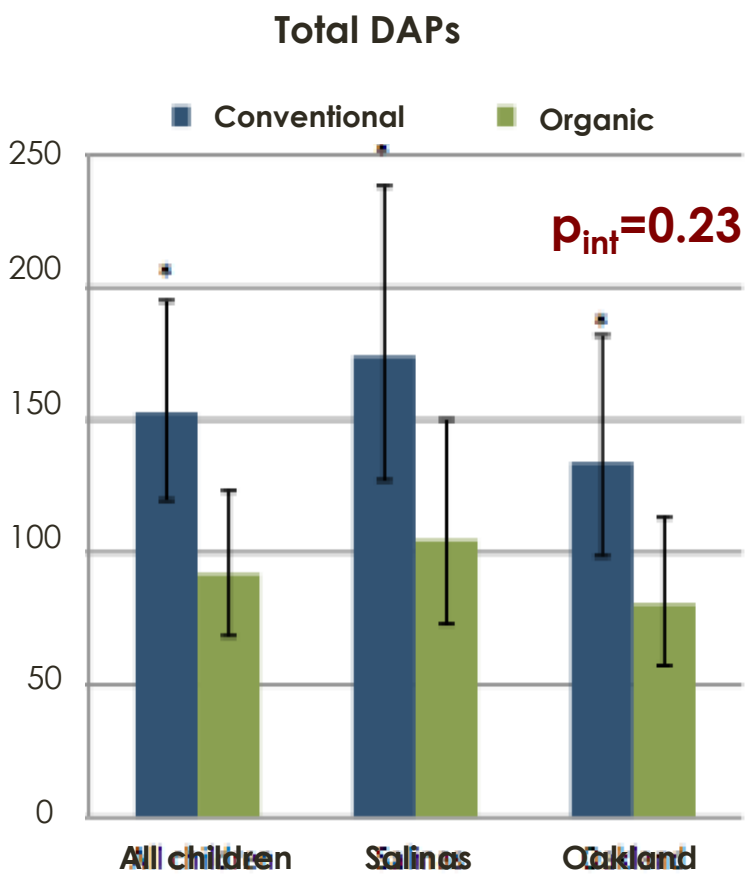
-40%



Bradman and Quiros et al 2015

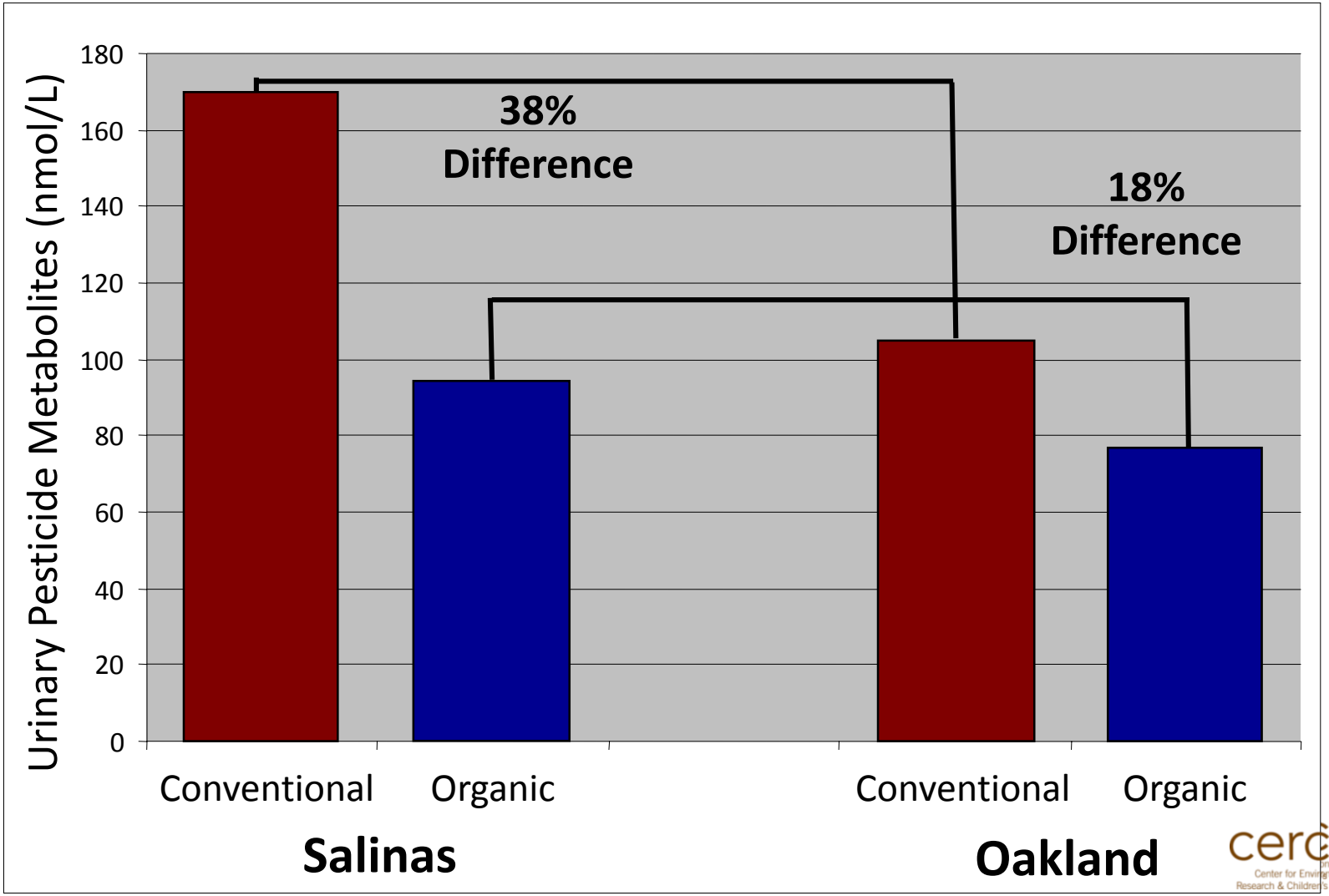
Total DMs/DAPs: Estimated effect of the organic diet did NOT differ by location





Bradman and Quiros et al 2015

Salinas (Ag) vs. Oakland (Urban)
Living near agriculture also important



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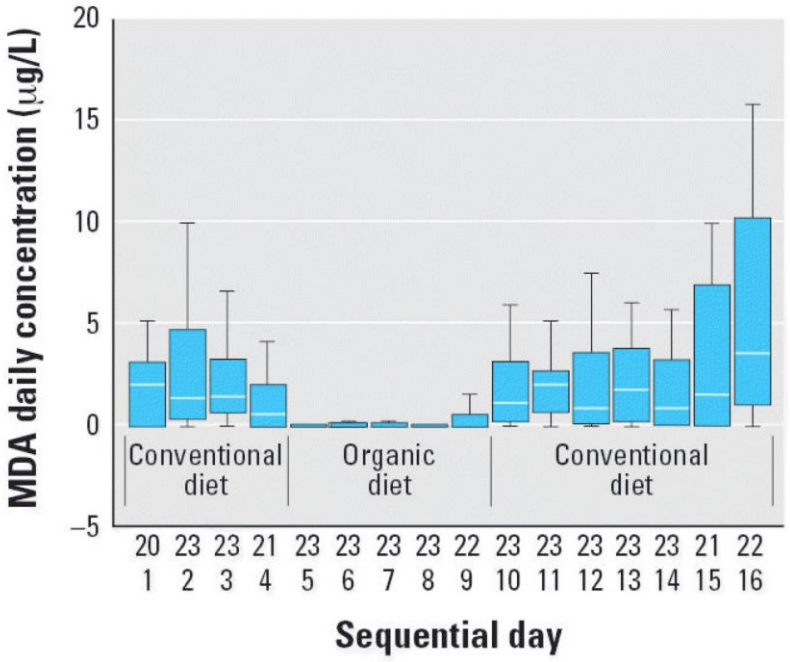
Results for DM/Total DAP metabolites similar to other studies

In Seattle children



Lu 2006

In Australian adults

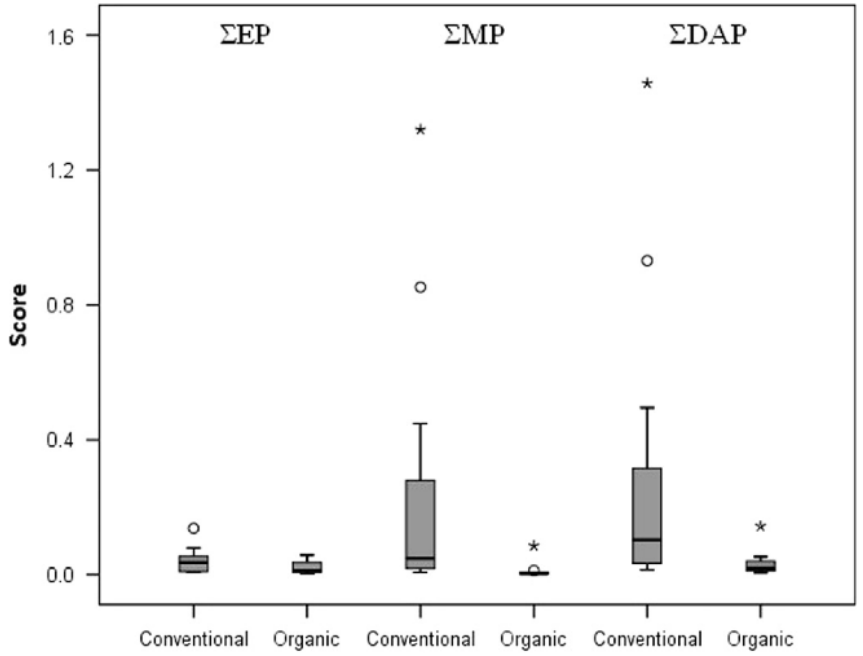
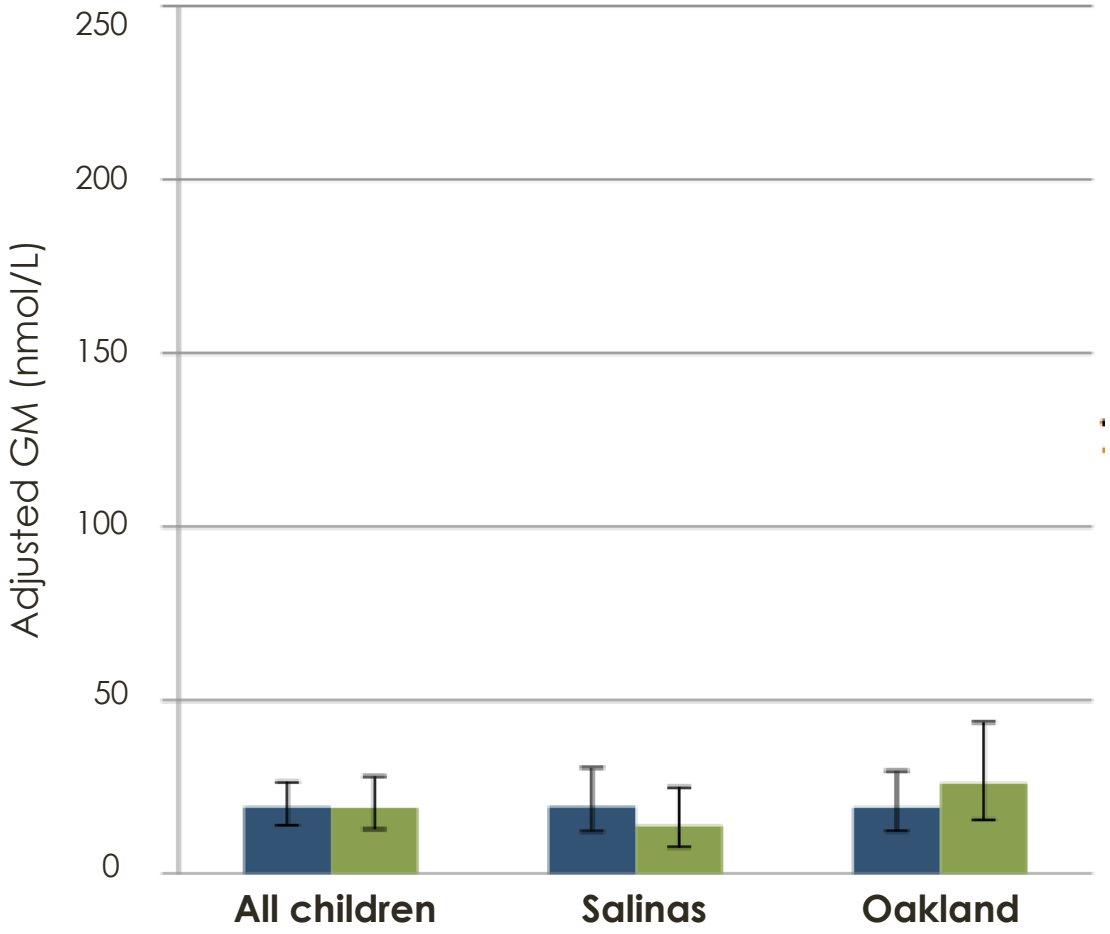


Fig. 3. ΣDAP, ΣMP and ΣEP (creatinine corrected). Mild outliers are marked with a circle (O) and extreme outliers are marked with an asterisk (*) on the boxplot.

Oates 2014

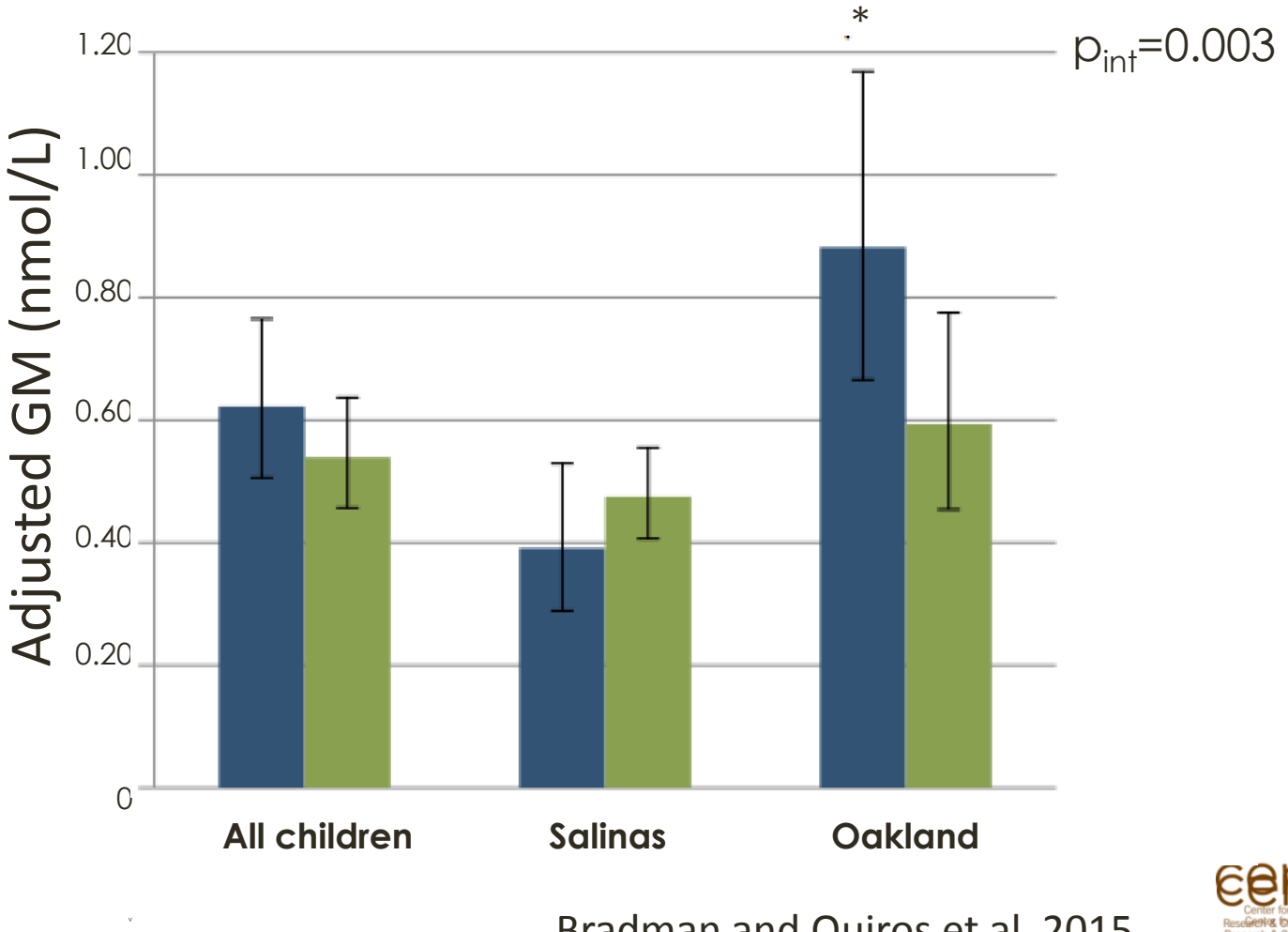
Total DEs: Decrease in levels during the organic phase (~1.2%) albeit non-significant for all children



p_{int}=0.14

Bradman and Quiros et al 2015

3-PBA: Borderline significant decrease (~13%); observed differences by location



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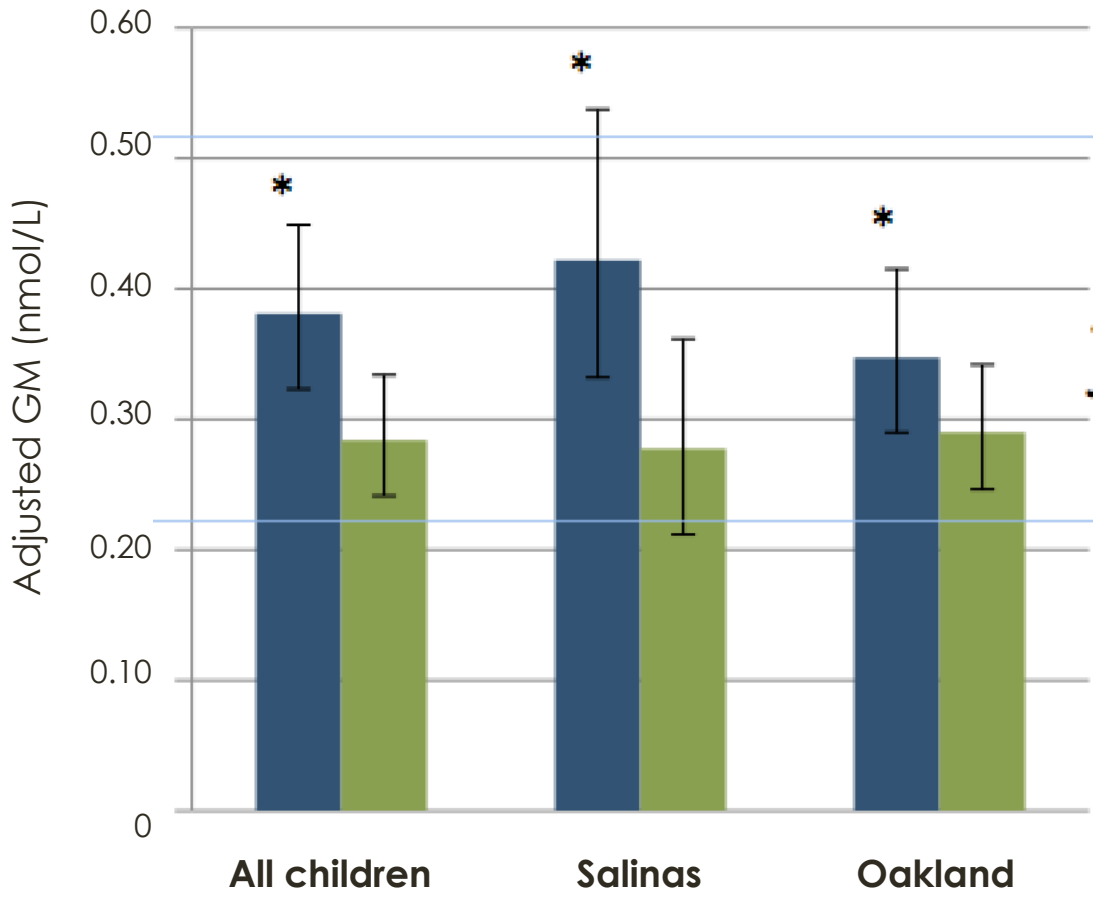
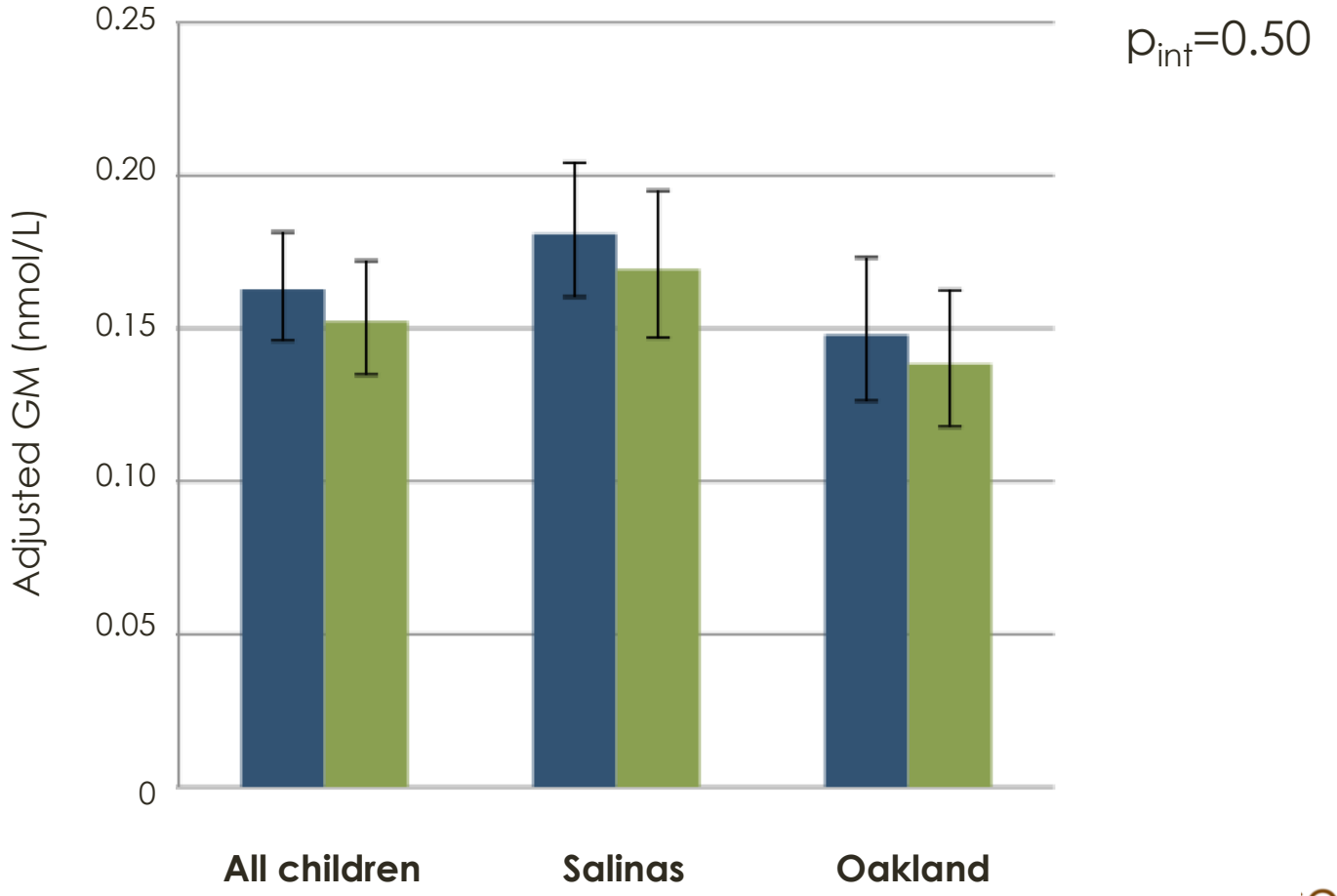
2,4-D: Significant decrease (~25%)during the diet phase; no differences by location



p_{int}=0.21

Bradman and Quiros et al 2015

MET: Decrease (~6%) during the diet phase albeit non-significant; no differences by location



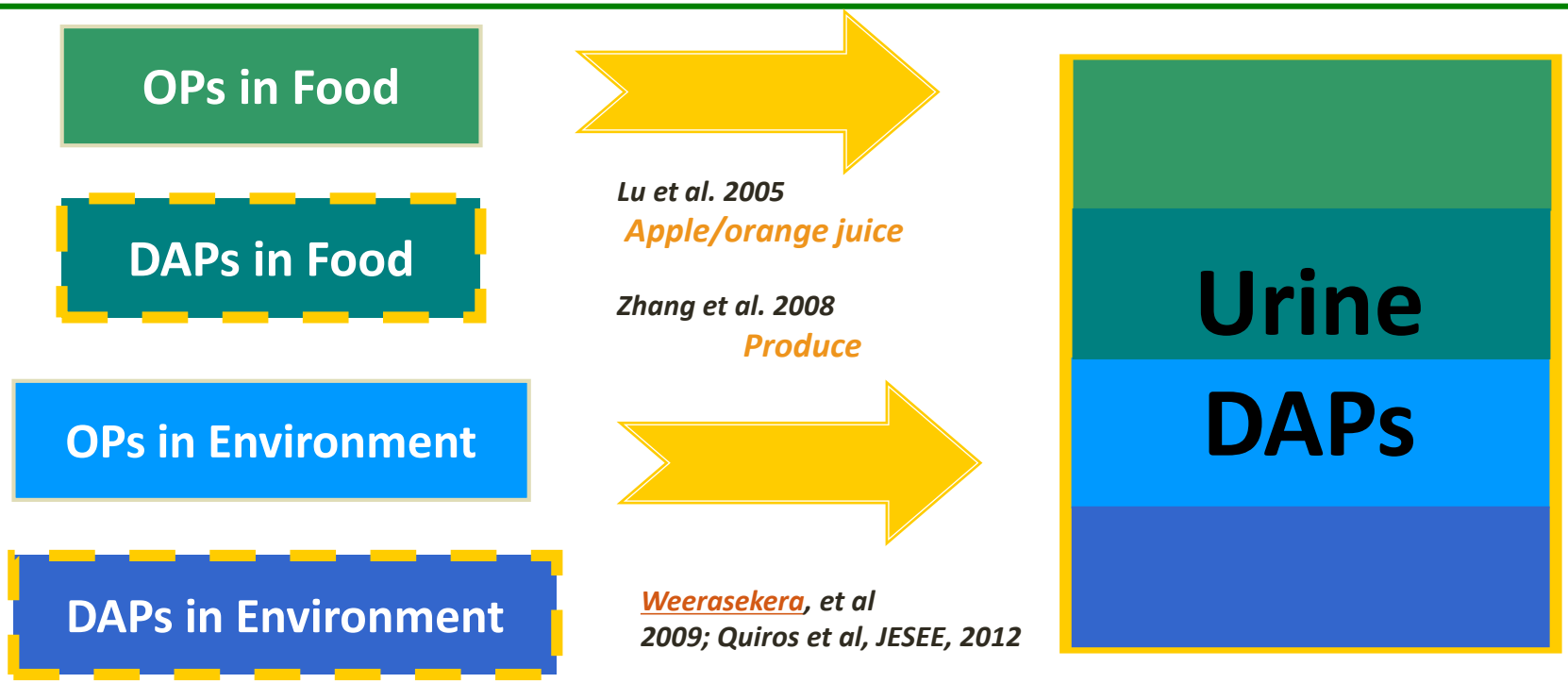
Bradman and Quiros et al 2015

Organic diet study: Summary of results

- Organic diet was associated with:
  - Significant decrease for total DMs, DAPs, 2,4-D
  - Borderline significant decrease for 3-PBA

- Results for OP metabolites similar to prior studies

Potential sources of DAPs in urine



Attributing urinary DAPs solely to parent OP compounds may lead to overestimation of exposure to parent OPs and exposure misclassification.

Conclusions

- Diet is a source of pesticide exposure.
- Typical commons sense recommendations if concerned about pesticide exposure:
- Thoroughly wash all produce under running water
- Consider organic produce

- **Eat a variety of fruits and vegetables!**

Bradman and Quiros et al 2015

For Discussion

- Diet seems to be a key factor influencing pesticide metabolite levels.
- The metabolite levels we have measured in mothers and child have been consistently associated with health outcomes in the children.
- Dietary exposure important for health outcomes?

For Discussion

- We have seen differences in associations of these biomarkers and health outcomes among different cohorts in pooled analyses. Perhaps reflect differences in exposure to preformed metabolites versus parent compounds?
- We are seeing that nearby agricultural pesticide use is associated with several key developmental outcomes independent of urinary biomarkers. Perhaps the urinary metabolites are driven by diet (shorter term) and the ag use information is a better measure of longer term environmental exposure.

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Thanks to our funders

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Passport Foundation

And a very special thanks to the families who have participated all these years!

CHAMACOS Study Photo


Thank YOU!!!
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End

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