

Considerations in Biomonitoring Pesticides

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Today's Talk

- Brief refresher on exposure biomarkers
- Recent epidemiologic analyses
- Where do children spend time and what pesticides are used there?
- Considerations for biomonitoring pesticides

Brief Refresher:

Urinary biomarkers for pesticide exposure

- High intra-individual variability (<http://www.biomonitoring.ca.gov/es/document-keywords/variability>).
- Metabolites may be class, but not pesticide-specific, creating uncertainty.
- Metabolites in urine may reflect exposure to preformed metabolites, not parent compounds.
- However:
 - Many studies show clear links between determinants of exposure and metabolite levels in urine.
 - Epidemiologic studies show consistent associations with adverse health outcomes.
 - Easy to collect, especially for children.

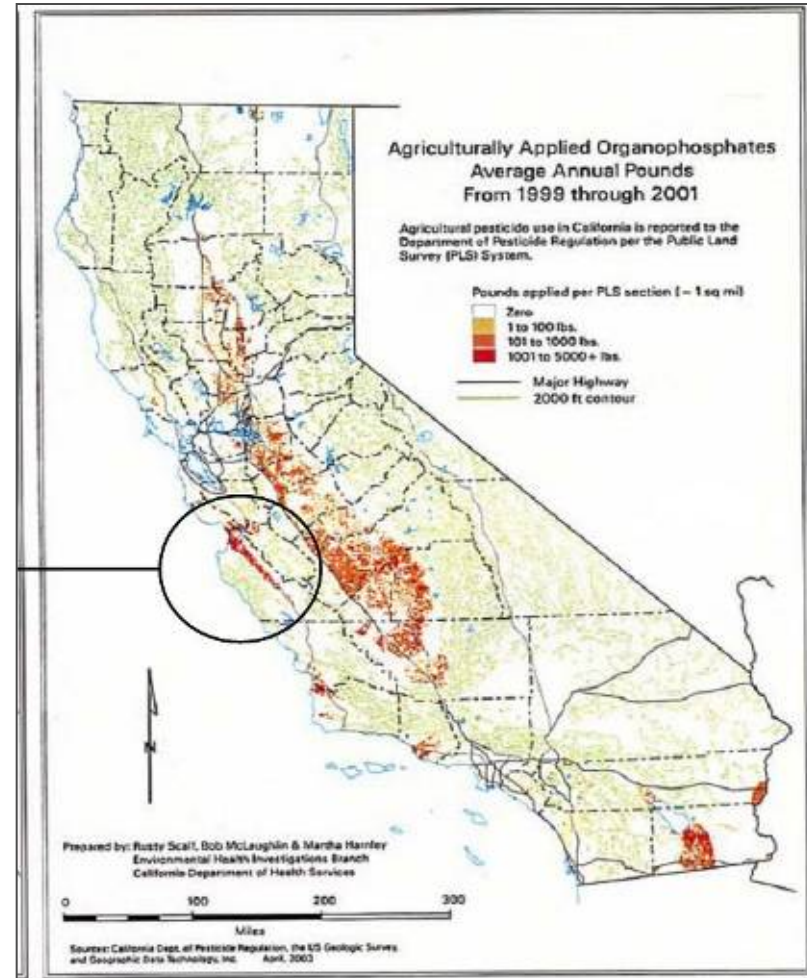
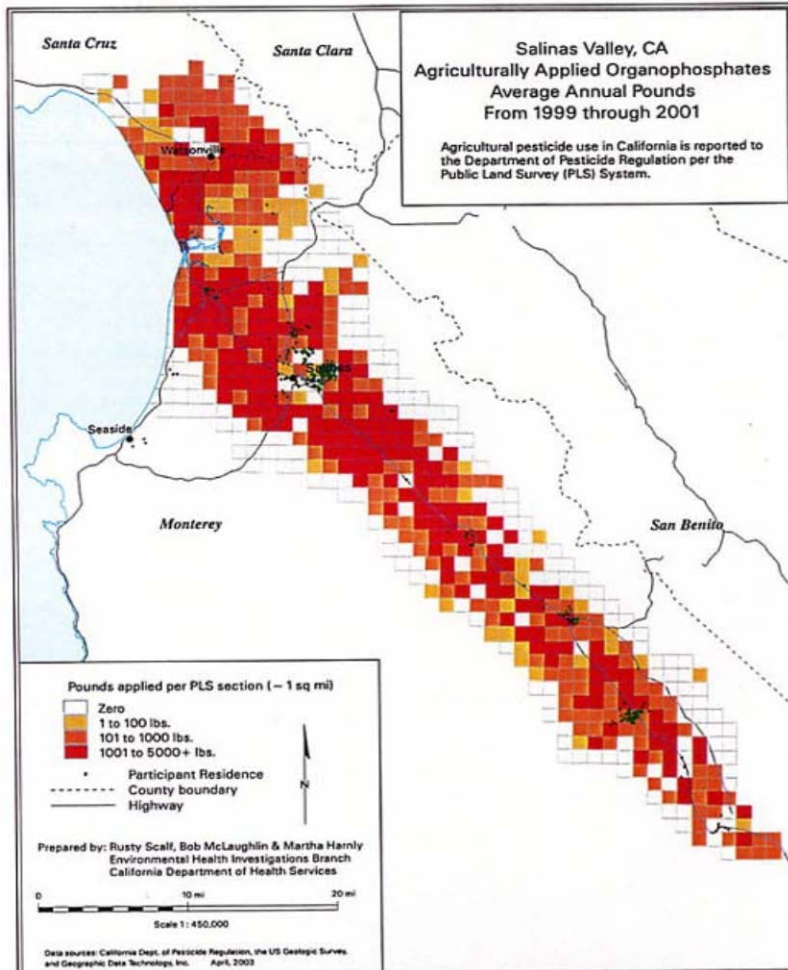
Epidemiologic Analyses



**CENTER FOR THE HEALTH ASSESSMENT OF
MOTHERS AND CHILDREN OF SALINAS**

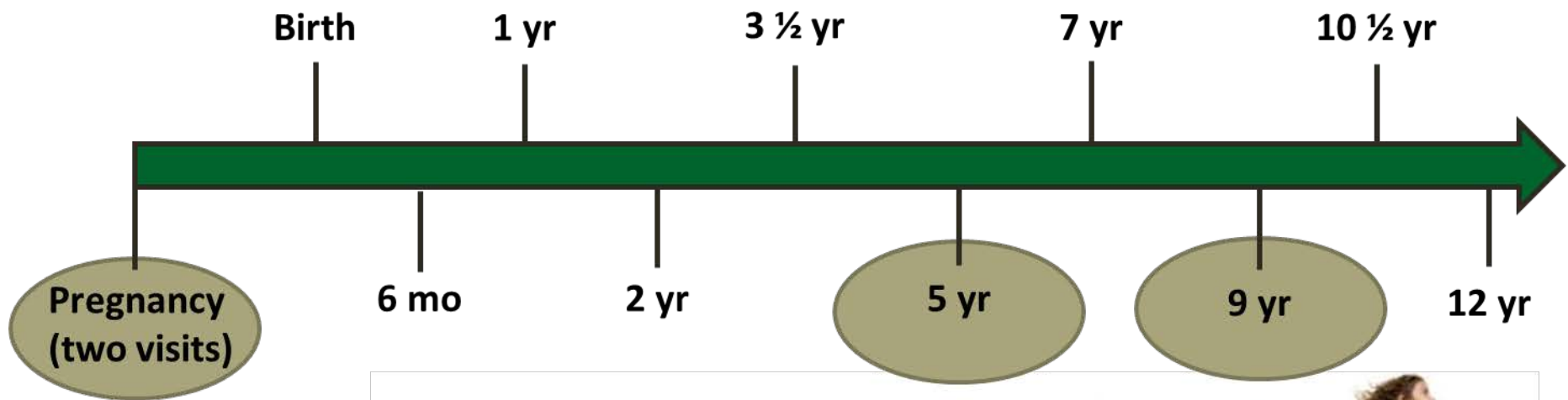
A birth cohort study investigating the health effects of environmental exposures in low income Mexican-American children living in an agricultural community.

Agriculturally Applied Organophosphates

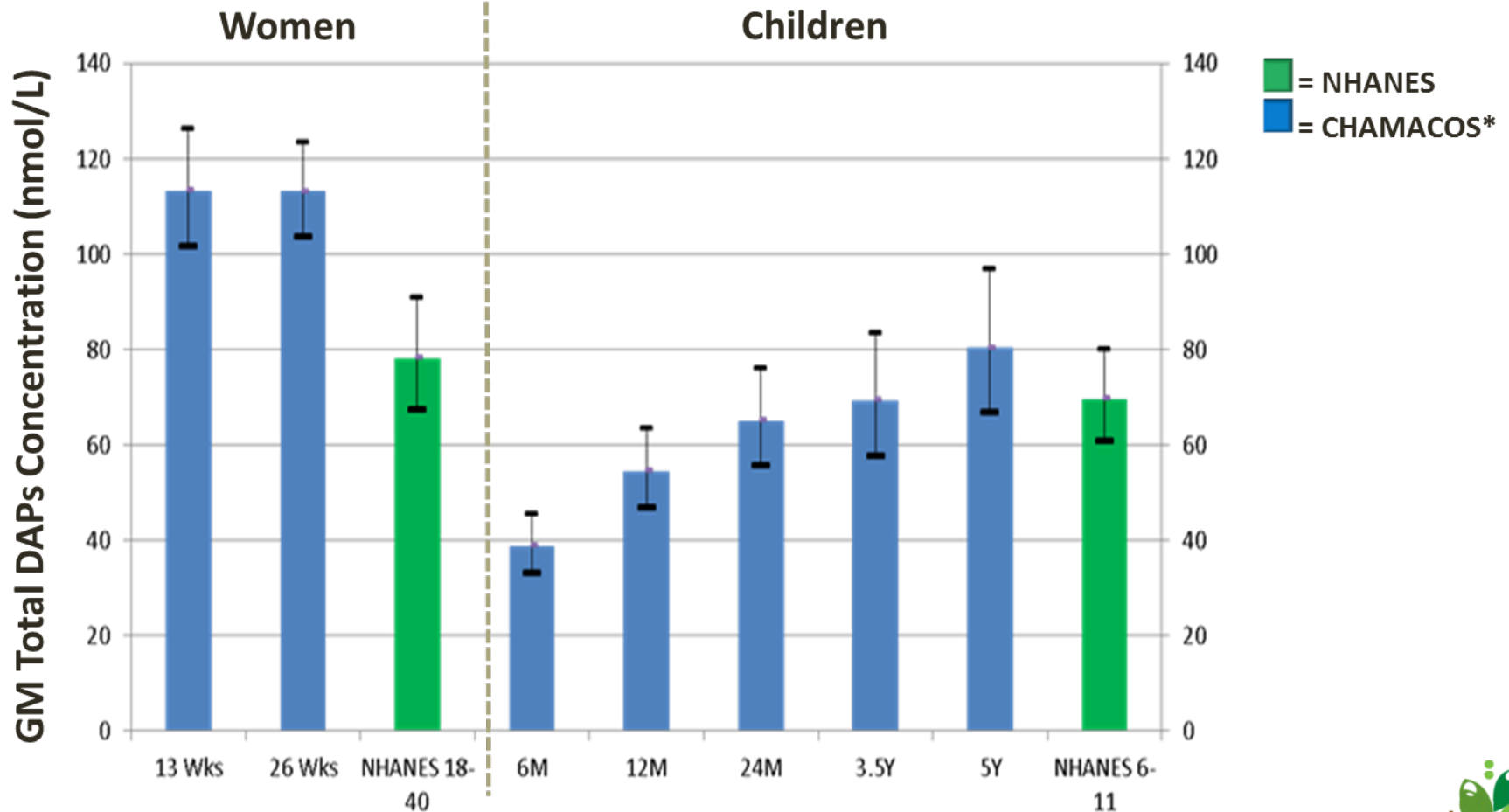




CHAMACOS Cohort Study



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



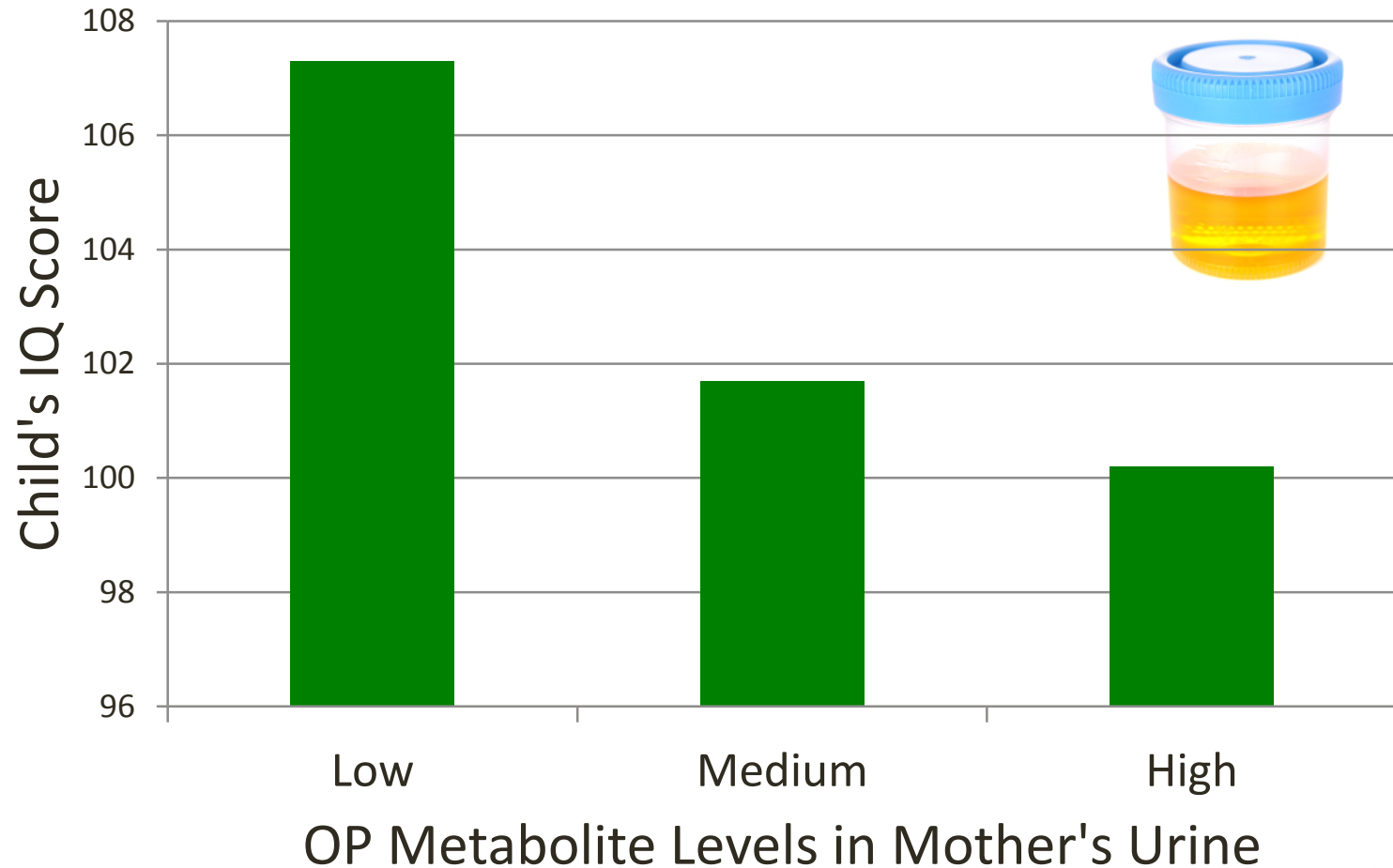


Prenatal DAP metabolite levels associated with:

- Shorter gestation (Eskenazi et al. 2004).
- Abnormal reflexes in newborns (Young et al. 2005).
- Pervasive developmental disorder (CBCL) at 2 years (Eskenazi et al. 2007).
- Poorer neurodevelopment scores through age 7 (Bouchard et al. 2011, Eskenazi et al. 2007).
- Attention deficits at 5 years (Marks et al. 2010).
- Consistency across age points.

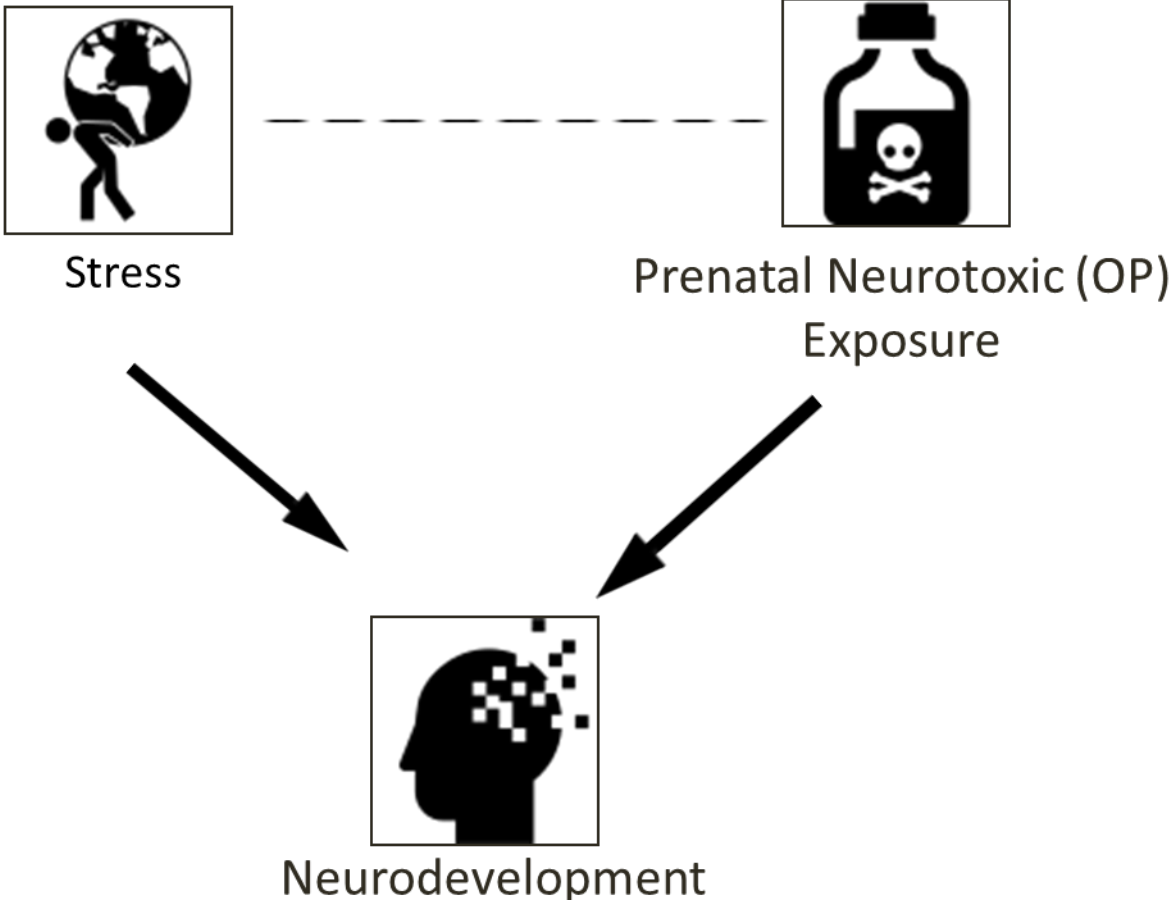
➤ New findings

And mothers' OP metabolite levels were also related to child's IQ at age 7



DOUBLE JEOPARDY!

Theoretical Framework





The children grew up with many adversities...



Photo by Seth Holmes

Housing Density >1.5 per room	49%
Rodents	32%
Food Insecurity	~38%
No blocks or stacking toys (12m)	~51%

Rosas et al., Jamer Diet Assoc, 2009, Bradman et al., 2005 EHP



Poor Housing Quality



Poor Housing Quality



Effect of OPs is **stronger** in children experiencing early life adversity

Among kids with low family adversity:

Prenatal DAPs → 2.5 point decrease in IQ
(not statistically significant)

Among kids with high family adversity:

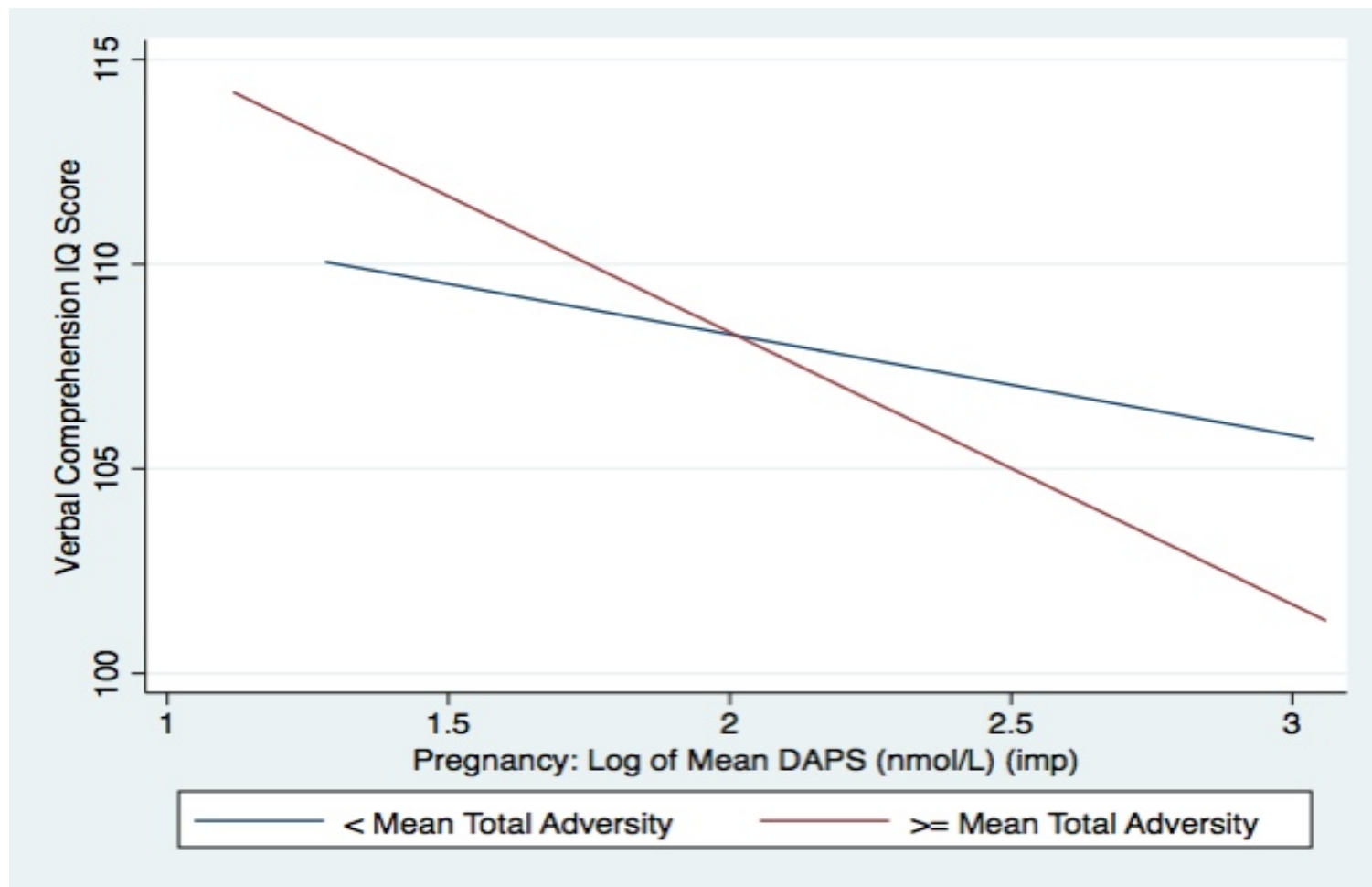
Prenatal DAPs → **8.2 point decrease in IQ**

Stein et al., 2016.

Verbal IQ at 7Y.

Controlling for maternal IQ score and language of neurological assessment

Interaction Between Adversity and DAPs on 7y IQ



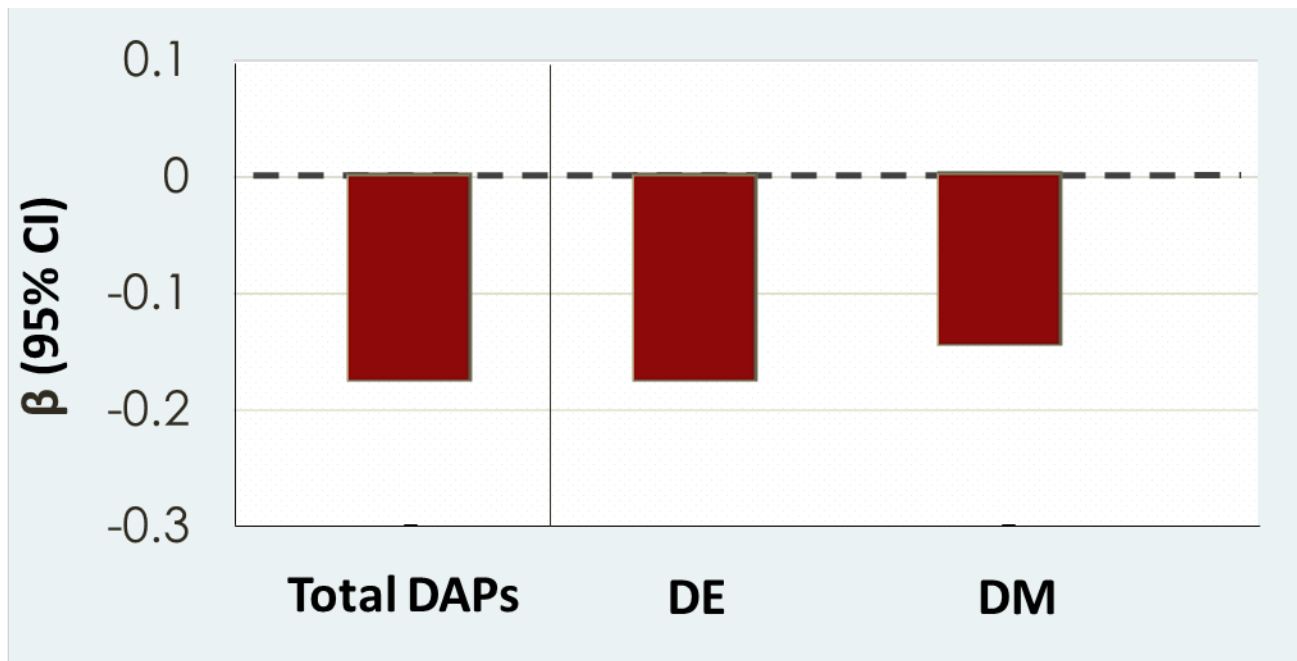
Model adjusted for maternal IQ score and language of neurological assessment.

Pesticides and Asthma



- Acute OP pesticide exposure associated with respiratory distress
- Some occupational studies show association of OP exposure and poorer respiratory outcomes

Postnatal DAPs (AUC) associated with reduced lung function (FEV₁) at age 7



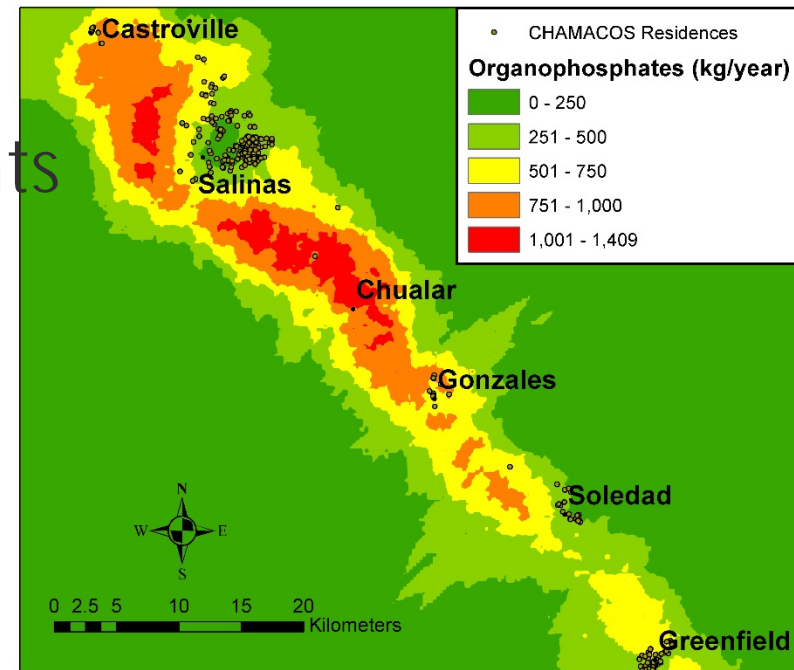
Adjusted for:
Child's gender
Child's age
Maternal smoking
ETS
Season of birth
PM2.5
Breastfeeding
Mold
Traffic
Roaches

Prenatal DAPs are not associated with lung function

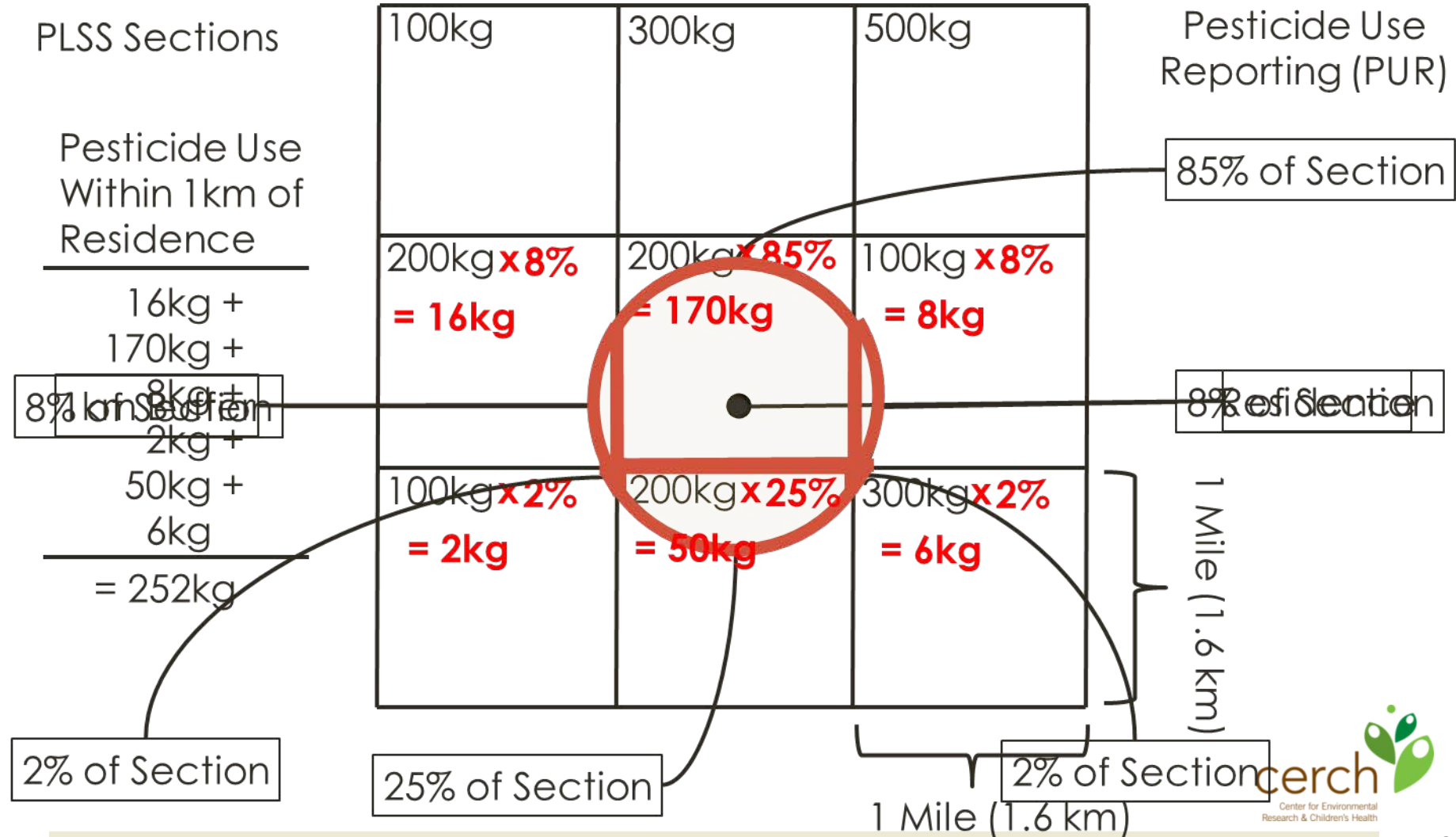
Nearby Pesticide Use

Pesticide Use Reporting (PUR) Data:

- Mandatory in California since 1990
- Provides the following:
 - Pesticide active ingredients
 - Pounds applied
 - Application date
 - Location to a square-mile section
 - Crop treated

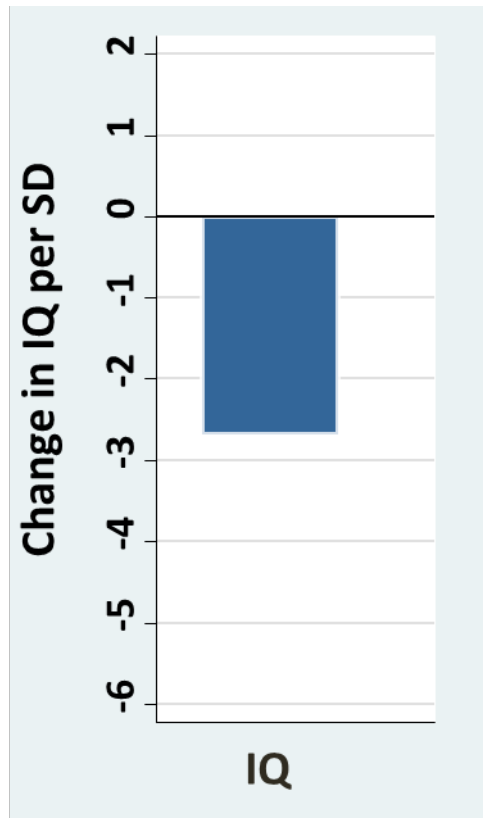


Methods – Pesticide Use Residential Proximity

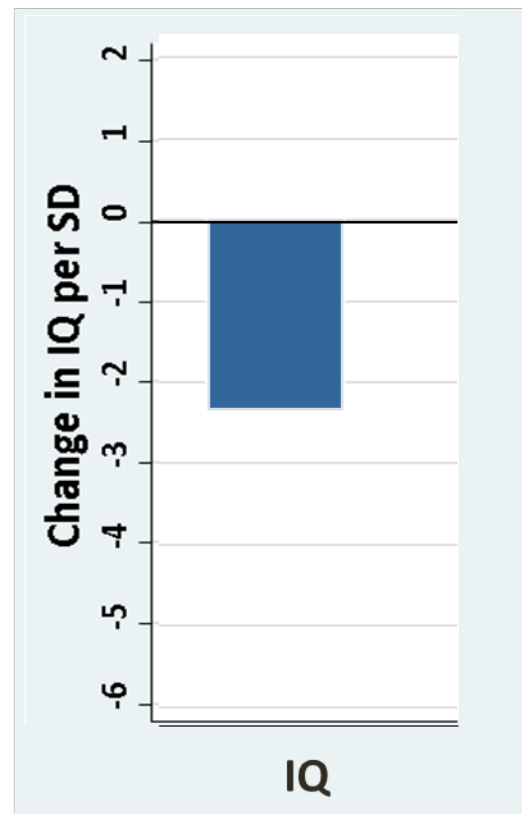


Two Different Exposure Methods: OPs Associated with Decreased IQ at age 7

Urinary DAPs



Nearby agricultural OP use (PUR)



Adjusted for: child's age, sex, language of assessment, maternal education, maternal intelligence, household poverty level, maternal depression, maternal country of birth and HOME score.
Adjusted for prenatal DAPs

Bouchard et al., EHP, 2011

Gunier et al., 2016

PUR data and 7y IQ

With increase in OP use within 1 km of mother's home during pregnancy:

→ 2 point decrease in IQ

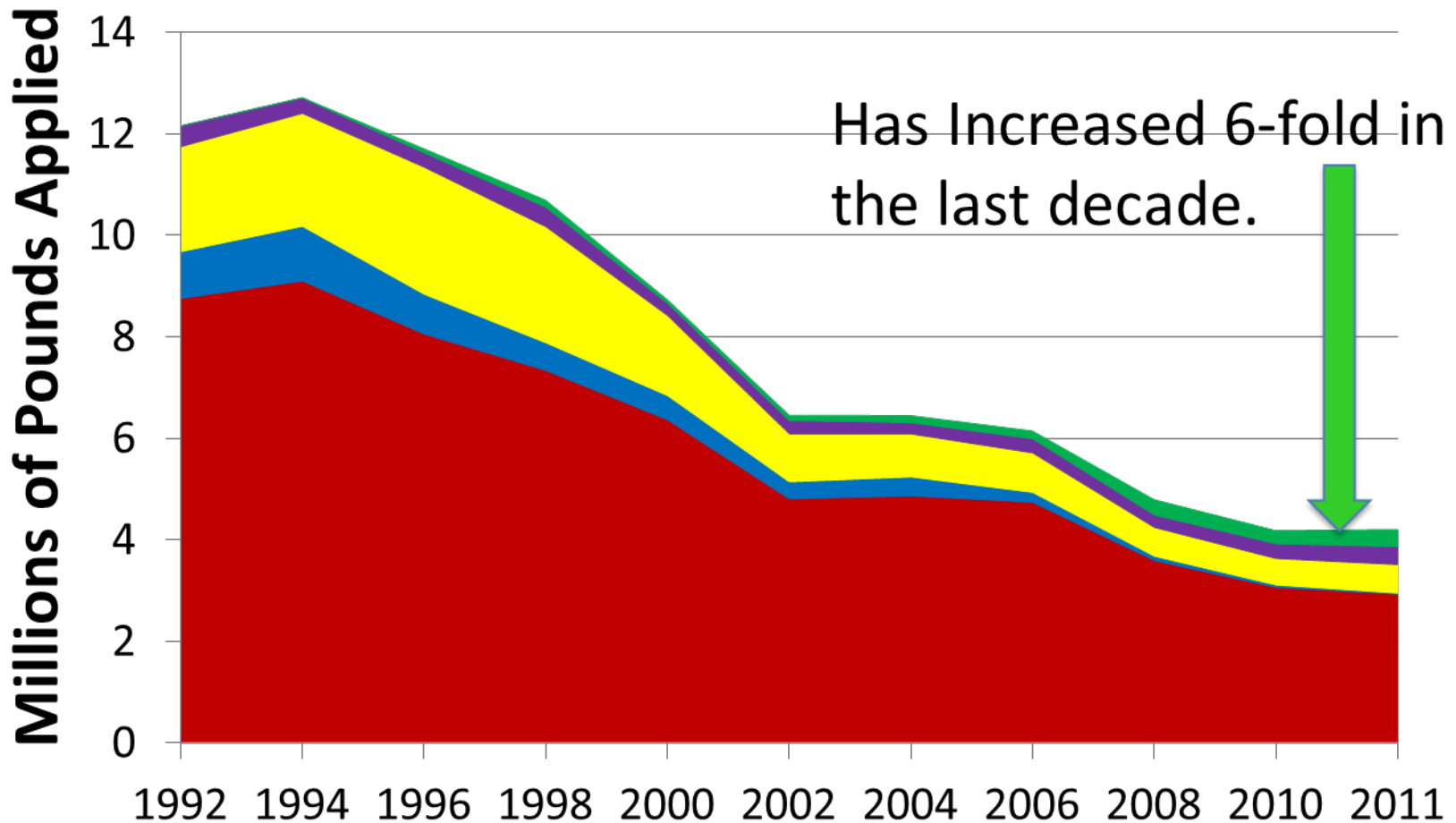
- Similar to what we saw with OP metabolites in urine
- PUR and urine both **independently** associated with IQ.
- PUR and urinary metabolites reflect different pathways/timeframe of exposure or pesticides?
Strongest individual PUR slope for oxydemeton-methyl.

Where do children spend time and what pesticides are used there? Implications for biomonitoring.

- Agricultural communities
- Homes
- Childcare

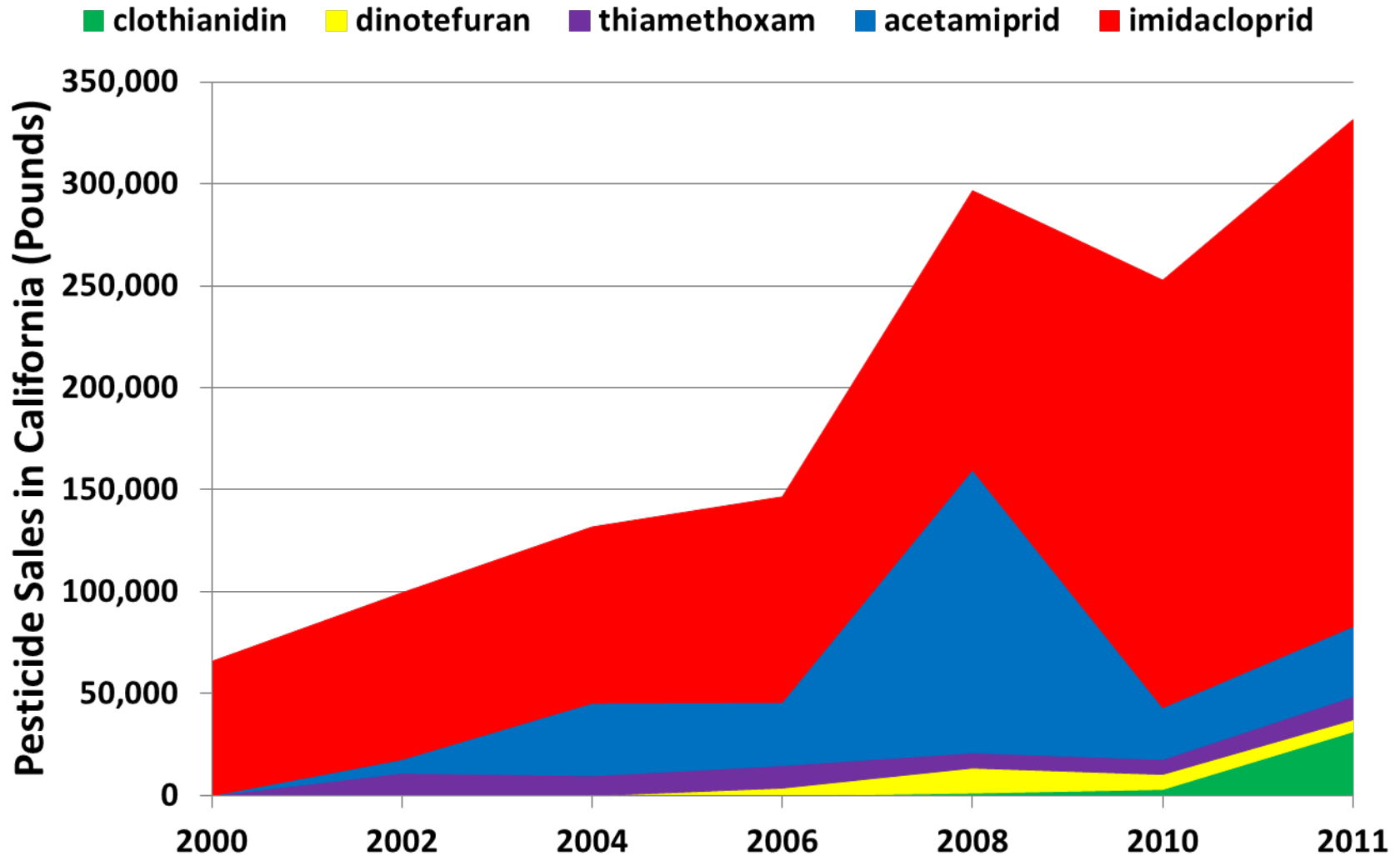
Trend of declining insecticide use in California

■ Organophosphates ■ Organochlorines ■ Carbamates ■ Pyrethroids ■ Neonicotinoids



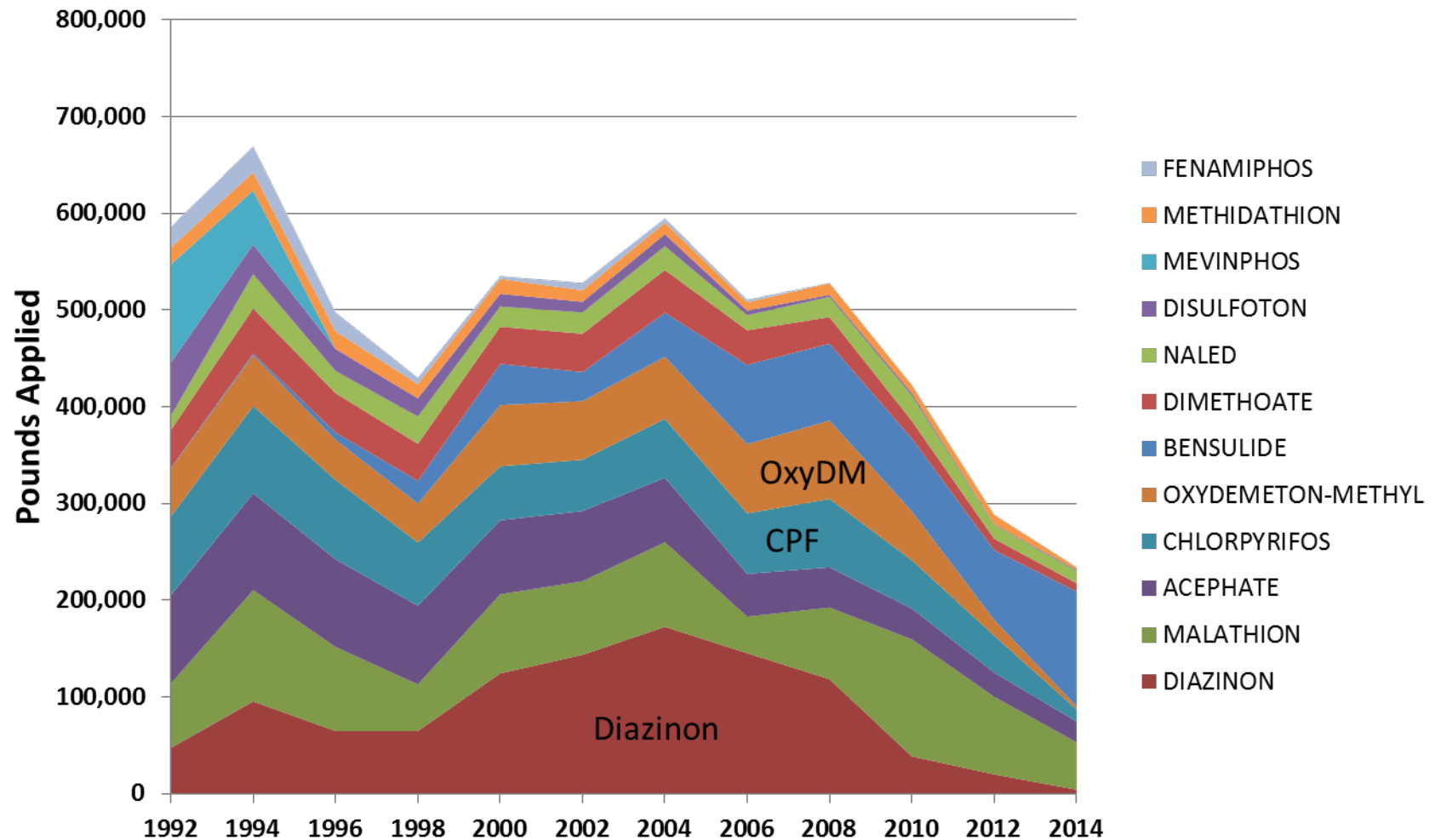
Source: California Department of Pesticide Regulation, 2013

Neonicotinoid Agricultural Pesticide Use in California



Source: California Department of Pesticide Regulation – Pesticide Use Report Data

Mixtures change: Organophosphate use in Monterey County 1992 – 2014



Source: California Department of Pesticide Regulation – Pesticide Use Report Data

Home pesticide use

- Dominated by pyrethroids
- Increasing use of neonicotinoids
- Commonly used on pets with many new materials-
 - Imadicloprid
 - Fipronil
 - Selamectin
 - Pyriproxyfen
 - Methoprene
 - Pyriproxyfen
 - Others

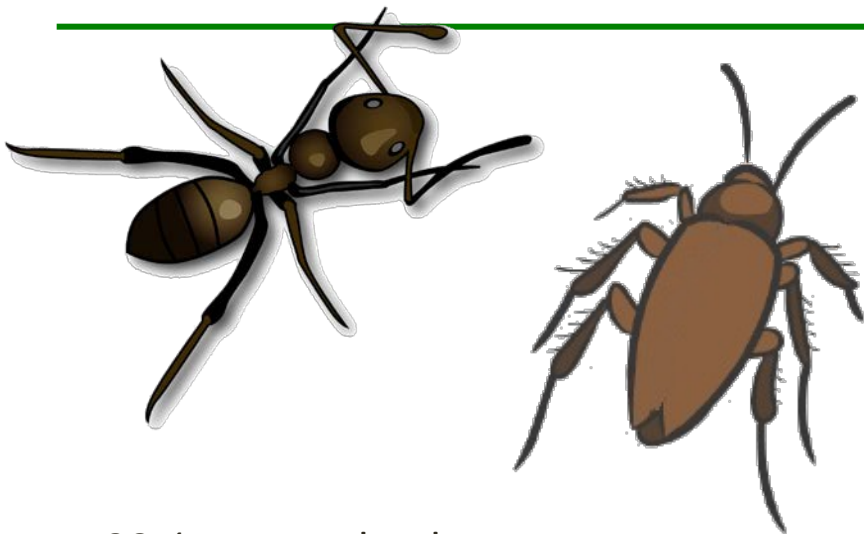


Child care in California

- ~45,000 licensed facilities in California (2012)
- ~1 million children in licensed child care facilities
- Some children spend up to 50 hours a week in child care



Pest problems in California child care centers



- 90% reported at least one pest problem
- About half reported using spray pesticides
- About 20% reported monthly or more frequent applications

Pest Management and Pesticide Use

in California Child Care Centers



Prepared for THE CALIFORNIA DEPARTMENT OF PESTICIDE REGULATION
by THE CENTER FOR CHILDREN'S ENVIRONMENTAL HEALTH RESEARCH,
UC BERKELEY SCHOOL OF PUBLIC HEALTH

June 2010

Bradman et al. 2010

Pesticides frequently detected (>90%) or used in California childcare facilities

Detected in dust:

- Diazinon – ag. use, prior indoor use
- Chlorpyrifos – ag. use, prior indoor use
- Permethrin – indoor use, some ag. use
- Bifenthrin – indoor use
- Dacthal – ag. use

Bradman et al. 2012

Reported use:

- Pyrethroids
- Bromadiolone
- Fipronil
- Indoxacarb
- Difethialone
- Dinotefuran
- Imidacloprid

DPR PUR (2014)

DPR reporting pesticide use reporting requirements under the Healthy Schools Act will greatly improve school/childcare PUR data starting in 2016.

Considerations for biomonitoring pesticides

- Need for more information on variability
 - Spot versus 24 hour samples
 - Frequency of sampling to meaningfully characterize exposure
- Must evaluate potential for exposure to preformed metabolites in the environment
- Pesticide use does not necessarily equal exposure
- Prioritize monitoring for pesticides used in environments where children spend time.

Thanks to our funders



Questions/Discussion

END