

# OP Pesticide Exposures and Neurodevelopment in Children from Farmworker Families



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## Objectives

- To estimate sources, pathways and levels of *in utero* and *postnatal pesticide exposures* of children living in an agricultural community.
- To determine the relationship of pesticide exposure and:
  - neurodevelopment
  - growth
  - respiratory disease

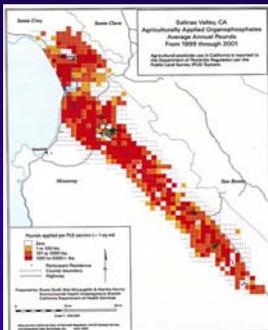
## Center for the Health Assessment of Mothers and Children of Salinas 1998 - present



## CHAMACOS Study Area



## Pesticide Use in the Salinas Valley



500,000+ pounds of organophosphate pesticides used annually



## Characteristics of CHAMACOS Mothers (N=601)

- 92% Spanish-speaking
- 85% born in Mexico; 54% ≤ 5 years in U.S.
- 96% living within 200% of poverty
- 44% 6<sup>th</sup> grade education or less
- 44% worked in agriculture during pregnancy
- 84% other agricultural workers in home

## CHAMACOS is a longitudinal birth cohort study

	1 <sup>st</sup> Tri	2 <sup>nd</sup> Tri	Delivery	6 M	1 Y	2 Y	3½ Y	5 Y	7 Y
Maternal Questionnaire	✓	✓	✓	✓	✓	✓	✓	✓	✓
Paternal Questionnaire			✓						
Neurodevelopmental Assessment			✓	✓	✓	✓	✓	✓	✓
Home inspection	✓			✓	✓	✓	✓	✓	
Respiratory Function Tests								✓	✓
School Performance									✓

## CHAMACOS Biological Specimen Collection

	1 <sup>st</sup> Tri	2 <sup>nd</sup> Tri	Delivery	6 M	1 Y	2 Y	3½ Y	5 Y	7 Y
Maternal Urine	✓	✓	✓	✓					
Paternal Urine			✓						
Maternal Blood		✓	✓						
Cord Blood			✓						
Breast Milk			✓	✓					
Child Urine				✓	✓	✓	✓	✓	
Child Blood					✓	✓		✓	✓
Child Saliva							✓	✓	

## Pesticide Exposures

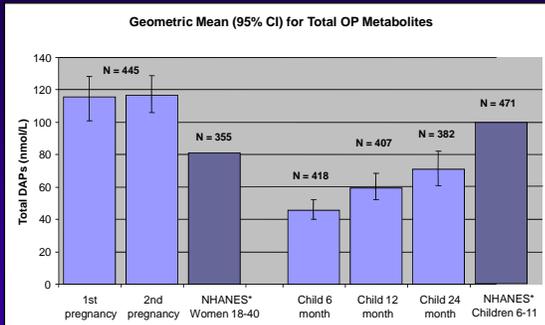


## Organophosphate Pesticide Use in the Salinas Valley, 2001



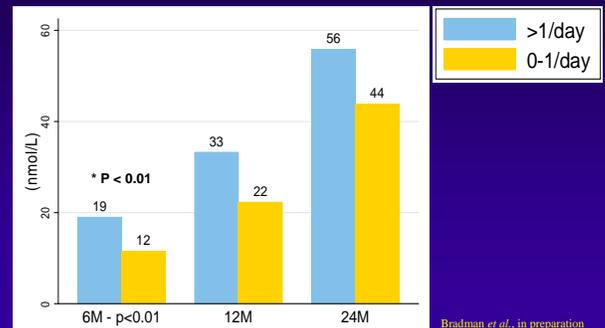
OP Pesticide	Pounds	Excreted in urine as
Malathion	96,520	Dimethyl (DM) phosphates ~220,000 lbs. (42%)
Oxydemeton-methyl	57,859	
Dimethoate	34,224	
Naled	17,045	
Methidathion	14,220	Diethyl (DE) phosphates ~199,000 lbs. (38%)
Diazinon	133,537	
Chlorpyrifos	54,945	
Disulfoton	10,216	Other ~104,000 lbs. (20%)
Acephate	71,725	
Bensulide	32,669	
<b>Total</b>	<b>~520,000</b>	

## Prenatal and Child OP Metabolites in CHAMACOS and National Reference\*

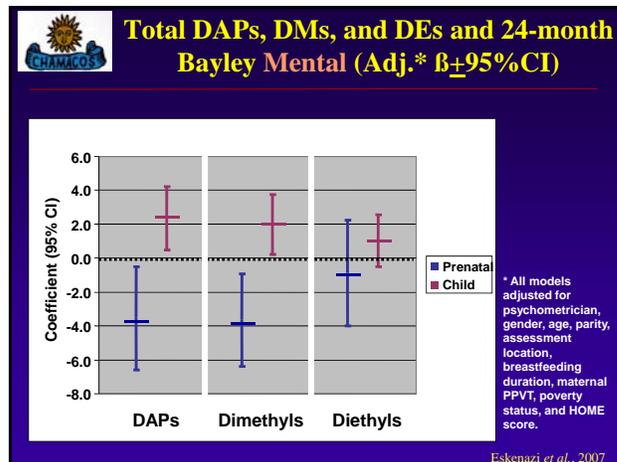
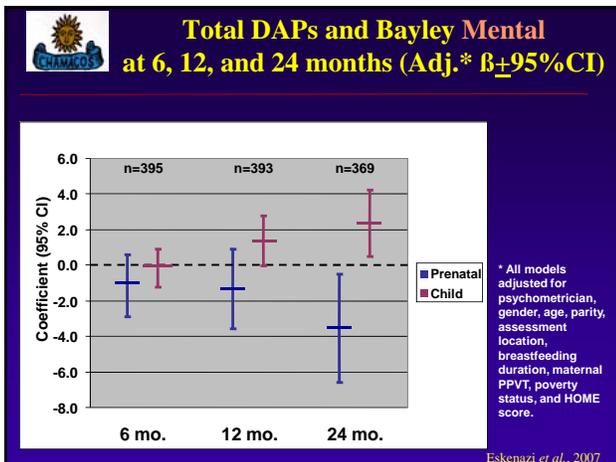
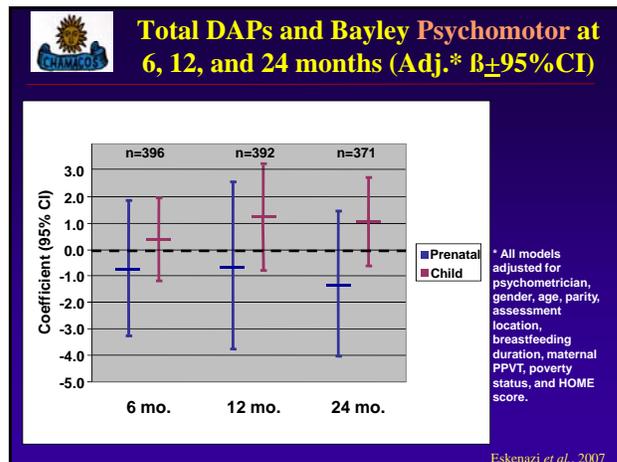
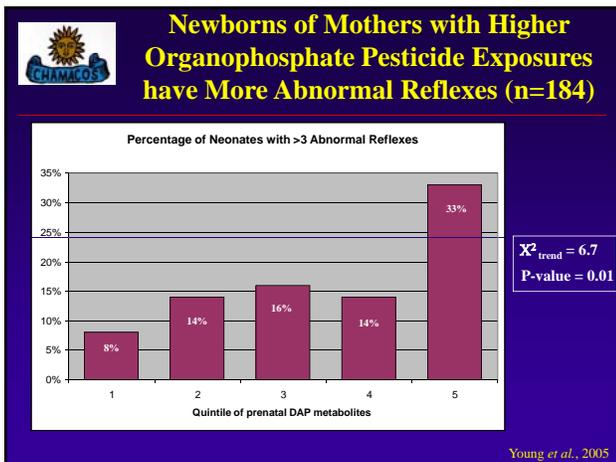
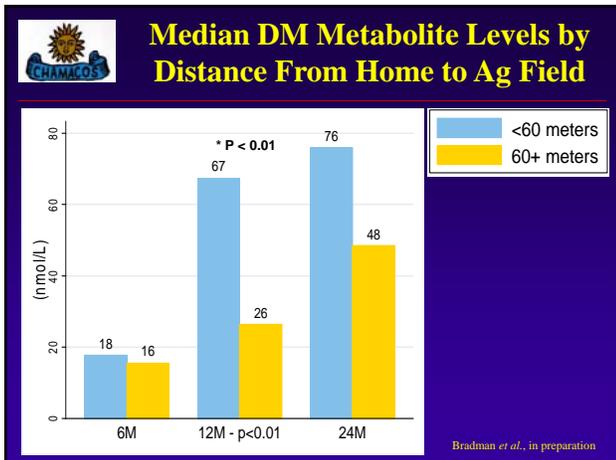


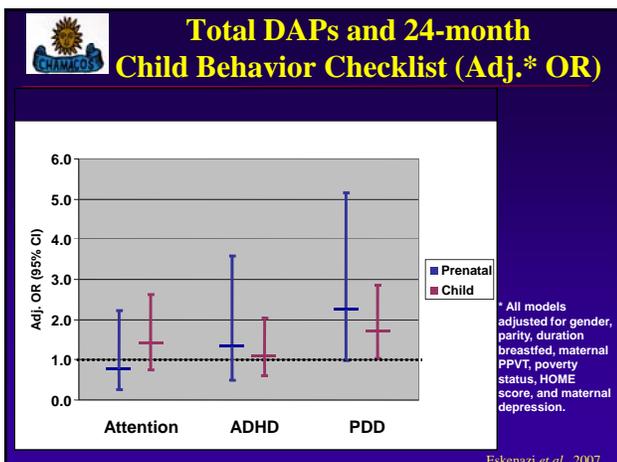
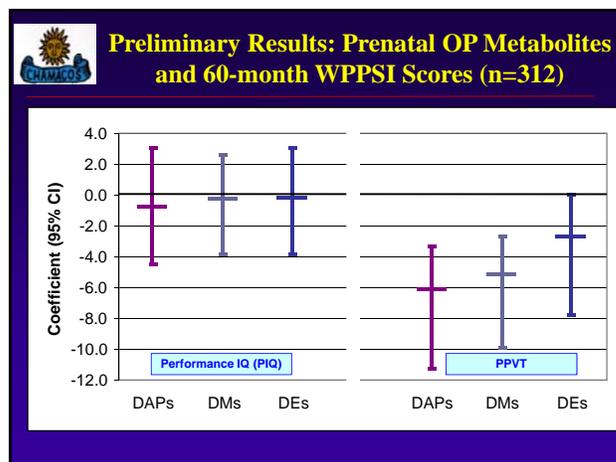
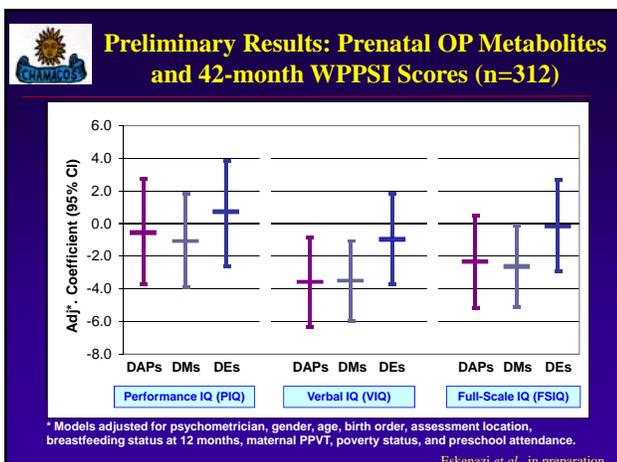
\* National Health and Nutrition Examination Survey

## Median DM Metabolite Levels by Fruit and Vegetable consumption



Bradman et al., in preparation





Mary Wolff, Stephanie Engel, Gertrud Berkowitz  
Mount Sinai School of Medicine

Virginia Rauh, Robin Wyatt, Frederica Perera  
Columbia University

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University of California, Berkeley

### Biomarkers of Prenatal OP Pesticide Exposures

	In Urine	In Blood
	Dialkyl Phosphates (DAPs)	Chlorpyrifos (CPF)
Berkeley	X	
Mt. Sinai	X	
Columbia		X

### Early Childhood Neurodevelopmental Outcomes

	Brazelton	Bayley				WPPSI	
	Neonatal	6M	1Y	2Y	3Y	3.5Y	5Y
Berkeley	X	X	X	X		X	X*
Mt. Sinai	X		X	X			
Columbia			X	X	X		X

\* Verbal IQ assessed with PPVT

## Early Childhood Neurobehavioral Outcomes

	Child Behavior Checklist (CBCL)		
	2Y	3Y	3.5Y
Berkeley	X		X
Mt. Sinai			
Columbia		X	

## AGRICULTURAL CALIFORNIA

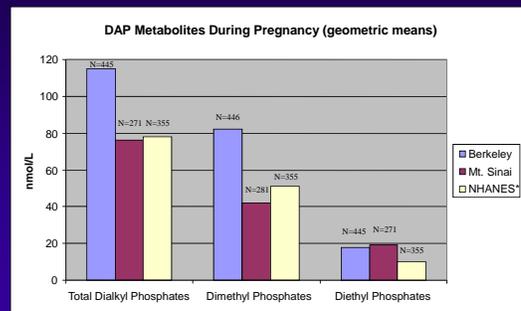


## URBAN NEW YORK

## Demographics of Study Populations

	Berkeley (%)	Mt. Sinai (%)	Columbia (%)
<b>Race/Ethnicity</b>			
Non-Hispanic White	1	20	--
African-American	--	27	35
Hispanic	Mexican 97	Mex, PR 51	Dominican 65
Other	2	1	--
<b>Married</b>	82	29	29
<b>&lt; High school</b>	81	32	35

## Comparison of Urinary Dialkyl Phosphate (DAP) Metabolite Levels



\* NHANES data are for women aged 18-40

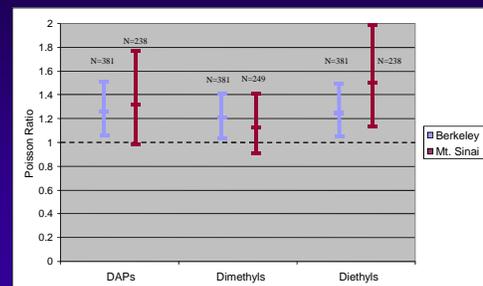
## Associations with 7 Brazelton Clusters

	DAPs
Berkeley	6/7 No associations
Mt Sinai	6/7 No associations

**EXCEPT....**

Young *et al.* 2005; Engel *et al.* 2007

## Association between DAPs and Brazelton reflexes in both cohorts



Young *et al.* 2005; Engel *et al.* 2007

## Prenatal OPs and Bayley Psychomotor Development Index

	Berkeley (Log <sub>10</sub> DAPs) Adj β	Mt. Sinai (Log <sub>10</sub> DAPs) Adj β	Columbia (High v. Low CPF) Adj β
6 Months	-0.7	In prep	--
1 Year	-0.6		-3.3
2 Years	-1.3		1.2
3 Years	--		-6.5**

\*\* p < 0.05

Eskenazi *et al.* 2007; Engel *et al.* in preparation; Rauh *et al.* 2006

## Prenatal OPs and Bayley Mental Development Index

	Berkeley (Log <sub>10</sub> DAPs) Adj β	Mt. Sinai (Log <sub>10</sub> DAPs) Adj β	Columbia (High v. Low CPF) Adj β
6 Months	-1.2	in prep	--
1 Year	-1.3		-0.3
2 Years	-3.5**		-1.5
3 Years	--		-3.3*

\* p < 0.1; \*\* p < 0.05

Eskenazi *et al.* 2007; Engel *et al.* in preparation; Rauh *et al.* 2006

## Prenatal OPs and Child Behavior Checklist

	Berkeley (Log <sub>10</sub> DAPs)		Columbia (High v. Low CPF)
	2 Y Adj OR	3.5 Y Adj OR	3 Y Adj OR
Attention Problems	0.8	in prep	11.3*
Attention Deficit/Hyperactivity	1.3		6.5*
Pervasive Developmental Disorder	2.3**		5.4*

\* p < 0.1, \*\* p < 0.05

Eskenazi *et al.* 2007; Eskenazi *et al.* in preparation; Rauh *et al.* 2006

## In summary...

- Three scientifically-rigorous, cohort studies
  - Different populations
  - Different exposure levels and sources
  - Exposure measured using biomarkers in urine (metabolites) and blood (parent compound)
- Despite these differences, some patterns emerge...

## In summary...

- Prenatal OP exposure associated with:
  - Increased odds of abnormal reflexes in neonates
  - Poorer mental development in 2 and 3 year olds
  - Poorer verbal IQ in 3½ and 5 year olds
  - Increased odds of pervasive developmental disorder



## Investigators

### Exposure Studies

- Asa Bradman
- Tom McKone
- Dana Barr CDC
- Rosemary Castorina
- Martha Harnly, DHS
- Jim Leckie, Stanford
- Marcia Nishioka, Batelle
- Jackie Schwartz

### Health Studies

- Brenda Eskenazi
- Ira Tager
- Kim Harley
- Laura Fenster, DHS
- Caroline Johnson
- Michael Lipssett, DHS
- Janet Macher, DHS

### Mechanism Studies

- Nina Holland
- John Casida

### Biostatistical Core

- Nick Jewell
- Alan Hubbard
- Amy Marks

### Intervention and Community Outreach

- Abbey Alkon, UCSF
- Lisa Goldman
- Alicia Salvatore
- Jorge Hernandez Clinica

### Clinica de Salud

- Jacki Sedgwick
- Max Cuevas

### Natividad Medical Center

- Marc Tunzi

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