The Work to Home Pesticide Exposure Pathway

How to Protect Pregnant Women And Children

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Topics

- Work to Home Exposures
- Children’s Vulnerability
- Prevention
Work to Home Studies

- Pesticide residues in yard soil and house dust significantly higher in homes of agriculture worker. *(Simcox et al., 1995)*

- Pesticide by-products in urine higher in children of agriculture workers. *(Loewenherz et al., 1997)*

- House pesticide dust levels 7x higher *(Lu et al., 2000)*

- Residues in house dust and vehicle dust of agricultural workers were significantly correlated. *(Curl et al., 2002)*

- Metabolites for agricultural workers and their children were significantly correlated. *(Curl et al., 2002)*
Yard and House Dust Residues

- Dust and soil samples tested for pesticide residues in play areas
- Farming (within 200 meters of an orchard vs. non-farming (> ¼ mile from a farm)
- Residues in house dust > soil in all homes
- Residues in farming > Non farming households

Profession and proximity to orchards are related to pesticide residues in homes

Simcox et al., 1995
Pesticide By Products in Farm Children’s Urines

- Children of applicators compared to non agricultural children
- Living close (200’) compared to (> ¼ miles) from orchard
- Applicator children had 4 x more pesticide by-products in urine.
- The younger the child the more by-products
- The closer to the orchard greater chance of detecting pesticide by-product in urine

(Loewenherz et al., 1997)
Pesticide Residues in Urine, Dust and Vehicles

- 109 children & their homes
- Classified by occupation & distance from orchard
- Hand & surface wipes
- Dust & urine samples

- AG homes 7 x more pesticide in dust
- AG children 5 x the pesticide metabolite load
- Living 200’ from orchard more dust and urinary loads
- Evidence on some hands and steering wheels

(Lu et al. 2000)
OP Dust & Urinary Concentrates

Family Status and Proximity

(Lu et al., 2000)
Children’s Vulnerability

- Behavioral factors
- Biological factors
- Bigger doses
- Long term effects @ low level exposure
Behaviors

- **Hand to mouth:** Taste their environment
- **Near the ground:** Spend more time on the ground
- **Outdoors:** Spend more time outside
- **Diet:** Consume more per weight (water and fruits)
## Behavior:

soil ingestion

<table>
<thead>
<tr>
<th></th>
<th>2.5 year old</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil ingestion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indoor</td>
<td>50mg</td>
<td>20mg</td>
</tr>
<tr>
<td>Outdoor</td>
<td>60mg</td>
<td>0.4mg</td>
</tr>
</tbody>
</table>

Diet

- **Drinks 2 x** more water per their weight than an adult
- **Eats 12x** more apples per their weight than an adult
Pesticides in Urine of 22 Children
Before, During, and After Organic Diet Intervention

Lu et al. 2005 Environ Health Perspect on-line
Child's Biological Factors

- Body works **faster** (higher metabolic rate)
- More **skin** per body weight
- Developing **organs**
Biology - Higher Dose By:

1. Skin
   - More permeable: highest at birth
   - 2.7 x more skin surface/weight than adults

2. Lungs
   - Inhales more per day (1.7x) than adult
Vulnerability to Health Effects: Organs Still Developing

<table>
<thead>
<tr>
<th>Nervous System</th>
<th>Sex organs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lungs</td>
<td>Kidneys</td>
</tr>
<tr>
<td>Bones</td>
<td>Immune</td>
</tr>
<tr>
<td>Metabolism</td>
<td>Digestive System</td>
</tr>
</tbody>
</table>

“A little kid goes from a single cell to a laughing, sociable, intelligent, friendly human being over the course of two years. That’s dramatic growth and development!”

Kenneth Olden, PhD, former Director, National Institute of Environmental Health Sciences
Impacts on Children

Studies on low level OP exposures among children

- The younger the child the greater consequences of OP exposure on development
  - Fetus
  - Soon after birth
- Nerve cells affected
- Levels so low that they do not affect the cholinesterase but still damage developing nerve cells.
What is the Evidence?
Three Studies of Mother-Baby Pairs

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

Virginia Rauh, Robin Wyatt, Frederica Perera
Columbia University

Brenda Eskenazi, Kim Harley, Asa Bradman, Amy Marks
University of California, Berkeley
New York Studies

Following 700 mother/baby pairs for 7 years.

- Mother’s air intake for pesticides
- Mother’s blood
- Umbilical cord blood of baby

Followed 409 mother/baby pairs for 3 years.

- Mother’s urine
- Birth outcomes
- Development to age 2
600 pregnant Latina women farm working families living in Salinas, a heavy agriculture area.

- OP by-products in urine during pregnancy and after delivery
- Birth outcomes
# Biomarkers of Prenatal OP Pesticide Exposures

<table>
<thead>
<tr>
<th></th>
<th>In Urine</th>
<th>In Blood</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OP by products</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Dialkyl Phosphates)</td>
<td>Berkeley</td>
<td>Mt. Sinai</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Chlorpyrifos</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Kim Harley, PhD UC Berkeley Center for Children’s Environmental Health Research
# Early Childhood Neurodevelopmental Outcome Measurements

<table>
<thead>
<tr>
<th>Behavioral Assessment</th>
<th>Infant Development*</th>
<th>Pre-school Intelligence**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neonatal</strong></td>
<td><strong>6M</strong></td>
<td><strong>1Y</strong></td>
</tr>
<tr>
<td>Berkeley</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Mt. Sinai</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Columbia</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

* Baley: Tests motor, cognitive, language development
**Wechsler Preschool and Primary Scale of Intelligence (WPPSI)

*** Brazelton
**** Verbal IQ assessed with PPVT

Source: Kim Harley, PhD UC Berkeley Center for Children’s Environmental Health Research
## Early Childhood Behavioral Outcome Measurements

<table>
<thead>
<tr>
<th>Child Behavior Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Y</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>2Y</th>
<th>3Y</th>
<th>3.5Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berkeley</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Mt. Sinai</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Columbia</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Source: Kim Harley, PhD UC Berkeley Center for Children’s Environmental Health Research
AGRICULTURAL CALIFORNIA

Source: Kim Harley, PhD UC Berkeley Center for Children's Environmental Health Research

URBAN NEW YORK

Source: Kim Harley, PhD UC Berkeley Center for Children's Environmental Health Research
### Characteristics of Study Populations

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

Source: Kim Harley, PhD UC Berkeley Center for Children's Environmental Health Research
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...

Source: Kim Harley, PhD UC Berkeley Center for Children’s Environmental Health Research
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

Source: Kim Harley, PhD UC Berkeley Center for Children’s Environmental Health Research
Home Based Intervention

- Storing and washing work clothes
- Personal hygiene
- Effectiveness of home cleaning (McCauley)
- Community based: behavioral changes

Source: K Galvin PNASH
Work Based Interventions

- **Personal car vacuuming**
  - Family exposure
    - Cherry harvesters

- **Tracer-in-the-Tank**
  - Handler exposure
  - Family exposure
    - Pesticide handlers

Source: K Galvin PNASH
Minimizing work to home pesticide exposure

Reduciendo exposición de pesticidas del trabajo a la casa
Personal Car Vacuuming
Cherry Harvesters

- Central location
- Check out system
- $5 coupon
- 1-2x/week

Source: K Galvin PNASH
### OP* Load After Vehicle Vacuuming

<table>
<thead>
<tr>
<th>House</th>
<th>Vacuum control</th>
<th>1-4 times</th>
<th>5-8 times</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>µg/m²</td>
<td>mean</td>
<td>0.22</td>
<td>0.10</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>95% CI</td>
<td>0.10-0.48</td>
<td>0.02-0.42</td>
<td>0.01-0.11</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>7.7</td>
<td>7.8</td>
<td>7.9</td>
</tr>
</tbody>
</table>

* Azinphos methyl (Guthion)

Source: K Galvin PNASH
Conclusions

- Vehicle loadings higher than house loadings
- Vehicle vacuuming significantly reduced OP* load in homes
- Increased vacuuming frequency decreased OP load in homes

* Azinphos methyl (Guthion)

Source: K Galvin PNASH

http://www.hartfordmi.com/hartfordhistory/Scenic/HPI M2378sm_small1.jpg
Tracer-in-the-Tank

Source: K Galvin PNASH
Fluorescent Tracers

- Not visible in daylight
- Visible under UVA light
- Evaluation tool
  - Dermal exposure
  - Contamination
  - PPE Failure
- Educational tool

Source: K Galvin PNASH
Study Design

- “Tracer-in-the-Tank”
- Mixing, loading, & applying
- Observed handling activity
- Photographed FT
- Participatory Education

Source: K Galvin PNASH
Data Collection

Source: K Galvin PNASH
Hood

Source: K Galvin PNASH
Hood

Source: K Galvin PNASH
Neck

Source: K Galvin PNASH
Neck
Jacket Back

Source: K Galvin PNASH
Jacket Back

Source: K Galvin PNASH
Sleeve

Source: K Galvin PNASH
Sleeve

Source: K Galvin PNASH
Hood Neck

Source: K Galvin PNASH
Tracer in Tank Conclusions

- Demonstrated T-n-T method in fruit orchards during application
  - Exposure & contamination
  - PPE limitations & failures

- Handlers & managers benefited
  - Educational impact
  - Handlers participation/interaction
  - Problems were resolved promptly

Source: K Galvin PNASH