Pesticide Exposure and Child Health: New Evidence and Putting it into Practice

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- Dr. Karr and Dr. Curl have no disclosures to report
Outline

An introduction to a complex topic
How are children exposed?
Health Impacts

- Acute and chronic toxicity
- Emerging issues
  - Neonics - newer class of insecticides
  - Glyphosate – research in progress
  - COVID killers

Advising your patients
Resources
Complexity….
> 1.2 billion pounds of active ingredient
> 20,700 products
~ 1000 active ingredients
~ 4000 “inerts”
The pediatric care provider role

Secondary prevention – timely recognition of acute toxicity concerns

Primary prevention – informed and targeted anticipatory guidance
Chronic pesticide exposure – the importance of diet
“You may not feel any healthier right away, but you’ll definitely feel more smug.”
Try Organic Food

...or as your grandparents called it, “Food”
New study finds organic foods are healthier than conventionally grown foods

Organic Foods Not Necessarily Better
Study Questions Health Benefits of Eating Organic

Study of Organic Crops Finds Fewer Pesticides and More Antioxidants

Is It Worth Buying Organic? Maybe Not
New research questions whether organic produce and meats are really more nutritious or healthier than conventional varieties (MORE: Does Organic Food Turn You into a Jerk?)
Pesticide “spray drift” can be a problem for workers, neighboring crops and agricultural communities.
Parental Take-Home

How Pesticides Travel from the Work Place to the Home and Child
Evaluation of Take-Home Organophosphorus Pesticide Exposure among Agricultural Workers and Their Children

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This is why we should protect our kids. We need to get rid of any pesticides that we could bring home from the fields. Here are some tips.

- Wipe your shoes before coming in the house.
- Leave the shoes in a special spot near the door.
- Take a shower.
- Wash your hands and our kids’ hands.
Multiple sources of exposure

Residential Use – indoor/outdoor

School/Daycare – indoor/outdoor

Agricultural Use

Dietary

Drinking water

Rx – lice/scabies

Parks/ neighborhood

Wu X et al. Env Health 2013
Pediatric Health Implications

Recognition and Management of Pesticide Poisonings

www.niehs.nih.gov/research/supported/success/2016/rauh/index.cfm

Organophosphate/N Methyl Carbamate Insecticides

- **Important in acute poisoning reports**
- Widely used in agriculture, some home garden products
- Variable acute toxicity but many = high (class I and II)
- Well absorbed via inhalation, dermal, ingestion

- Malathion, Chlorpyrifos (Dursban), Phosmet, Carbaryl (Sevin), Methyl parathion (Pesticide label lists active ingredient)
OP/Carbamates Acute Neurotoxicity: Cholinesterase Inhibition

- Nausea, vomiting, diarrhea
- Weakness, twitching, paralysis
- Visual blurriness (meiosis), Confusion, lightheadedness, coma

Hypersecretion:
- Tearing
- Bronchial secretions, wheezing, edema
- Sweating, salivation, urination
Signs and Symptoms in a CHILD

More likely to have hypotonia & mental status changes such as lethargy and coma, seizures

eg. seizure occurrence based on case series:
- adults 2-3%
- children 22-25%

Classic cholinergic excess signs of hypersecretion are less likely to occur, particularly at initial presentation

**Often mistaken for viral illness (respiratory infection, gastroenteritis, meningitis)**

Case series found 80% of children with organophosphate poisoning were transferred with the wrong diagnosis

Pyrethroid Insecticides

Also neurotoxic but…. *Generally* less acutely toxic compared to OPs/ carbamates

Sites of action = Na & Cl channels; GABA, nicotinic acetylcholine, & peripheral benzodiazepine receptors = varied acute neurotoxicity

Generally low skin absorption (exposure via ingestion, inhalation)

- Type I – (permethrin)
- Type II (contain a cyano group) – cypermethrin, fenvalerate

**TYPE II** are more commonly associated with poisonings
Pyrethroid signs/symptoms

- Nonspecific symptoms - headache, fatigue, vomiting, diarrhea, and irritability
- Reflex hyperexcitability, tremor, choreoathetosis
- Similarities to OPS-hypersecretion, muscle fasciculation, pulmonary symptoms and seizures

And for lower dose exposures, (without symptoms above)

- Paresthesias - Skin irritation and paresthesias (burn/tingle/numb), often face (most commonly reported for Type II group)
Case Report

Home Use of a Pyrethroid-Containing Pesticide and Facial Paresthesia in a Toddler: A Case Report

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13 month old, previously healthy male

Acute onset of facial movements that seem like “twitching”

“...may be coincidental, but I think the timing is somewhat concerning that the family recently has been spraying for ants the last 2 weeks”
Combination Spray: Synthetic Pyrethroids

Bifenthrin (Type I)

Most commonly associated with human poisoning

Zeta-Cypermethrin (Type II – cyano group)
PEHSU, WA DOH Response

2 metabolites of cypermethrin could be tested in WA DOH State Lab

3 Phenoxybenzoic Acid (PBA) and Trans-DCCA

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<tr>
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<th>Sx start &amp; continue</th>
<th>Sx resolve, no notable sequelae</th>
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<tr>
<td></td>
<td>10/24/13-10/31/13</td>
<td>11/01/13</td>
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<tr>
<td>3-PBA</td>
<td>DOH education</td>
<td>11/15/13</td>
</tr>
<tr>
<td>mcg/g Cr</td>
<td>Use stopped, clean up, safe pest control</td>
<td>12/20/14</td>
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<tr>
<td></td>
<td>WA kids 6-11 years 50th % (95% CI)</td>
<td>WA kids 6-11 years 95th % (95% CI)</td>
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<tr>
<td>3-PBA</td>
<td>2.22</td>
<td>0.329</td>
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<tr>
<td>mcg/g Cr</td>
<td></td>
<td>0.53 (0.41-0.69)</td>
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<td></td>
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<td>7.47 (2.86-15.4)</td>
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<tr>
<td>trans-DCCA</td>
<td>3.82</td>
<td>0.453</td>
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<tr>
<td>Mcg/g Cr</td>
<td></td>
<td>&lt; LOD &lt; LOD-0.421)</td>
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<td>2.61 (1.4-15.8)</td>
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DOH Pesticide Incident Summary Report – Confirmed pesticide related illness
Chronic low dose effects

Mechanisms ≠ acute toxicity mechanisms
Concern for developmental toxicity

Epidemiological associations with major chronic morbidities of childhood:

Neurodevelopment/Neurobehavior (ADHD, Autism, Learning disability)
Pediatric cancer (Leukemia, brain)
Birth outcomes (premature birth, fetal growth, birth defects)
Other emerging data – asthma, diabetes

Significant Evidence Base: Early Life Chronic OP/PYR Pesticide Exposure & Adverse neurodevelopmental outcomes

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<thead>
<tr>
<th>Biological Plausibility/Toxicological Mechanisms</th>
<th>Organophosphates</th>
<th>Pyrethroids</th>
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<tr>
<td>Epi (X-Sectional)</td>
<td>↑ ADHD</td>
<td>↑ Special Ed, LD/ADHD</td>
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<tr>
<td>Epi (Prospective Cohort)</td>
<td>Many studies: Neonatal reflexes Toddler MDI/PDI Behavior (CBCL/BSID) Cognition (IQ) Symptoms ASD/ADHD</td>
<td>Several studies: Toddler MDI Cognition Behav probs/EF (BASC/BRIEF)</td>
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Meta analysis childhood cancers and exposure to home pesticides in childhood

![Graph showing odds ratios and weights for different cancers and pesticides]
Neonicatoinoids

- Newer class – developed to replace organophosphates/carbamates
- Exponential growth- in use in agriculture, also pet products
- Chemically similar to nicotine -nicotinic acetylcholine receptor (nAChR)
- Highly persistent in soil, crops
- Acetimiprid (ACE), Imidaclorpid (IMI), thiamethoxam (THO), clothianidin (CLO)
Neonics – child health concern???

- Animal models – endocrine disruption, reproductive toxicity
- Cross placenta and blood brain barrier
- New biomonitoring data – CDC/NHANES (Espina et al. Env Res 2019)
  - ~50% US population = at least one urinary metabolite detected
  - Children 3–5 years of age had higher concentrations of N-desmethyl acetamiprid than any other age groups
- Systematic review 2017, n = 4 population based epi studies (Cimino et al. Env Health Persp 2017)
  - Tetralogy of Fallot (AOR 2.4, 95% CI: 1.1, 5.4)
  - Anencephaly (AOR 2.9, 95% CI: 1.0, 8.2)
  - ASD (AOR 1.3, 95% (CrI): 0.78, 2.2)
My students’ textbook, page 343: 
“[Glyphosate] has no teratogenic, developmental or reproductive effects. Genotoxicity and carcinogenicity studies in animals were negative.”
Percent of San Bernardino study participants with measurable exposure to glyphosate

Source: Journal of the American Medical Association (JAMA), Oct 2017
Cynthia Curl, an environmental health scientist at Boise State University in Idaho who studies the chemical, said, "many assumptions have been made about the safety of glyphosate that are now being actively questioned. We will see an explosion of information about glyphosate, and it’s about time. We’re really playing catch-up on this one."
Conventional Group – 10 Women

Organic Group – 10 Women
24 weekly samples composited in 1 mL aliquots to create six “monthly” aggregate samples representing the second and third trimesters
Measurement of Agricultural and Dietary Glyphosate Exposure among Pregnant Women
• To gain a better understanding of pregnant women’s exposure to glyphosate

• (If exposed) to understand how much of that exposure is coming from where they live and how much is coming from what they eat
Participants will take part in a two-week organic and conventional dietary intervention study, in a cross-over design.

We will collect weekly urine samples throughout pregnancy, and daily urine samples during the dietary intervention, for a total of 36 samples per participant, and 1,440 samples in total.
40 pregnant women recruited as part of this proposed project.

- 20 living >10 miles from glyphosate-treated fields ("urban" participants)
  - 10 “urban” assigned an organic diet
  - 10 “urban” assigned a conventional diet
- 20 living <1 mile from a glyphosate-treated field ("near field" participants)
  - 10 “near field” assigned an organic diet
  - 10 “near field” assigned a conventional diet
Despite its extensive use, frequent environmental presence and potential toxicity, very little biomonitoring data exists to characterize human exposure to glyphosate.

This project aims to assess glyphosate exposure among a cohort of pregnant women and to quantify the relative contribution of agricultural and dietary sources to this exposure.

**AIM 1**
Assess between- and within-individual variability

**AIM 2**
Assess contribution of residential location in agricultural region

**AIM 3**
Assess dietary contribution
Antimicrobial Pesticides: COVID-19 Killers

Daily Exposures to Cleaners and Disinfectants
Reported to US Poison Control Centers
January-March 2018, 2019, 2020

MMWR April 24, 2020 / 69(16);496–498
Educate Families on Appropriate Use

- Know when & which surfaces should be cleaned and/or disinfected
- Cleaning with soap & water is sufficient (in most cases) for households where no one is sick
- Sanitize or wash hands when returning home before touching anything
- Choose safer sanitizers/disinfectants – look for the seal – and know what to avoid
  - Bleach, Quaternary Ammonium Compounds = asthmagens
- Follow label directions – allow for proper dry time, never mix products/chemicals
- Store cleaners, sanitizers, disinfectants, & cleaning tools out of reach from kids
- Keep areas well-ventilated during use

Safer options are available

Look for Safer Choice, Green Seal®, Ecologo® and Design for the Environment (DfE) labels on products.
**Key Terms**

**Cleaner**
Removes germs, dirt, and impurities from surfaces or objects. Works by using soap/detergent, water and friction to physically remove dirt and germs from surfaces. Cleaning before disinfecting reduces spreading infection more than disinfecting alone.

**Sanitizer**
Reduces germs on surfaces to levels considered safe for public health (usually 99.99%). Products must be EPA registered.

**Disinfectant**
Destroys almost all infectious germs, when used as the label directs on a surface. No effect on dirt, soil, or dust. Should be used where required by law, in high-risk and high-touch areas, or in case of infectious disease. Products must be EPA registered.
Non acute exposure “cases”

I’m worried about the pesticides in my garden/home/job – how can I protect my child?

Is organic food worth it?

What do low everyday low doses mean for health?
Encourage organic?

Why?

- Organic produce reduces pesticide exposure in children and there is evidence of potential adverse health impacts in children with low dose exposure
- Organic farming brings other environmental and occupational health benefits

Why not?

- Don’t want to discourage IMPORTANCE of fruit/vegetable in diet
- Expense

See Healthychildren.org “Is organic worth the price”? and “AAP weighs in for first time on organic foods for children”
Advising patients

- Wash and scrub produce with water (cleansers not necessary), throw away the outer leaves of leafy vegetables, and trim the skin and fat from poultry, fish and meats.
- Purchase organic when possible, but not at the expense of a diet rich in a variety of fresh fruits and vegetables.
Key Anticipatory Guidance

- Informed by Env Hx – occupational exposures in the household, young workers? Pesticide use/storage at home?
- Recommend wash hands and face and change out of contaminated clothes and shoes before returning home, entering car, and wash contaminated clothes separately from the rest of the laundry.
- Discuss safe storage
- Encourage use of low toxicity or non toxic pest control approaches for home/garden pest problems.
Resources


2. NW Pediatric Environmental Health Specialty Unit (NW PEHSU). 1-877-KID CHEM (Monday-Friday during office hours) or kidchem@uw.edu. (for acute management – Poison Center) [https://deohs.washington.edu/pehsu/](https://deohs.washington.edu/pehsu/)
   Factsheets available – pesticides, covid cleaning/disinfecting


6. Project LEAF (Limiting Exposures Around Families)
   Printable brochures (Eng/Spn) for ag workers on reducing pesticide exposure in children, including take-home exposures from occupational sources. [https://afop.org/health-safety/pesticide-safety/take-home-exposures/](https://afop.org/health-safety/pesticide-safety/take-home-exposures/)
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Thank - you

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