The Health Effects of Pesticides

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Let's talk about Drugs

- Intended to improve the human condition
- Known side effects when used correctly
- Are mis-used...intentionally and unintentionally
- Knowledge of health effects develops over time
- I use them!

Let's talk about Pesticides

- Intended to improve the human condition
- Known side effects when used correctly
- Are mis-used...intentionally and unintentionally
- Knowledge of health effects develops over time
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Beneficial health effects:

- Pesticides play a role in:
  1) Managing crop pests - Approximately 15 million children/year die due to malnutrition (UNICEF).

Since 1951, India has quadrupled grain production

Beneficial health effects:

- Pesticides play a role in:
  2) Managing human and livestock disease vectors - Average life expectancy...
US 1900=47 years; 2007=78.
Specific countries in Africa 2007=<40 years. HIV/AIDS reduction in adult labor to produce crops for local community. Herbicide use increasing.

Beneficial health effects:

- 5000 people die/day of malaria
  2001 deltamethrine bed net trial
    - 75% reduction in bites/person
    - 59% reduction in malaria incidence
  2007 WHO indoor spraying with DDT
    - 30 years after phasing it out
Cockroaches and flies vector enteric disease organisms

1 killer of children under 5
3) Managing critters that impact human “stuff”
   – Termites, bed bugs, fire ants, etc.

The Problem with Pesticides

- Regulated in a political system
- Toxic to ecosystems – biomagnification, etc.
- Toxic to living organisms (humans, other animals and plants)
- Used in accordance with Western cultural demand

Pesticides

- Insecticides
- Herbicides
- Miticides
- Fumigants
- Fungicides
- Wood Preservatives
- Rodenticides
- Growth Disrupters
- Nematicides
- Endocrine Disrupters

Regulated in a political system

- FIFRA (Federal Insecticide Fungicide & Rodenticide) – EPA Office of Pesticide Programs
- the “risk/benefit” mandate in terms of "unreasonable adverse effects"
- Science changes.....

Chlorpyrifos (Dursban, Lorsban) End-Use Products Cancellation Order 1/02
ENVIRONMENTAL PROTECTION AGENCY [OPP-34203J; FRL-6819-6-]
Chlorpyrifos; End-Use Products Cancellation Order AGENCY: Environmental Protection Agency (EPA). ACTION: Notice.
Toxic to ecosystems - biomagnification, etc.
• Pesticides are ubiquitous - Simonich & Hites, Science, 1995
• 97% of U.S. surface waters are contaminated with pesticides (100% of drinking water…)

Health effects of mis-use
• Agricultural pesticides are the most common means of suicide worldwide, resulting in more than 250,000 deaths each year. Pesticides were far more toxic to humans than the WHO ranks them based on animal studies – Dawson 2010 PLoS Medicine
• In April 2010, the U.S. Environmental Protection Agency (U.S. EPA) announced expanded use restrictions for rodenticide uses of aluminum and magnesium phosphate products in response to two deaths in Utah.

Knowledge of health effects develops over time...science changes
• Pesticides are linked to risks for cancer, birth defects, hormonal disruption, kidney, liver damage and neurological disorders - May 2010 LA Times: “Children with higher levels of the pesticide malathion in their urine seem to be at an increased risk of attention deficit hyperactivity disorder, or ADHD.”
• Pesticide use has been linked to increased risk of reduced head circumference in infants, congenital heart defect, non-Hodgkin’s lymphoma and childhood brain cancer. (e.g., Env. Health Perspectives, Am. J. of Public Health, Cancer)
• Fri, Jul 15, 2011 3:42 pm EDT (Reuters) - DuPont was sued on Friday by a Michigan golf club that alleges its widely used Impradis herbicide kills trees, reflecting a growing nationwide problem being investigated by a top U.S. regulator. Now a federal class action law suit.

Silent Toxicity
• Effects of SUBACUTE/CHRONIC exposure of neurotoxic pesticides on developing neurons are UNKNOWN
• Effects of MULTIPLE INTERACTIONS between neurotoxic pesticides over time on developing neurons are UNKNOWN

Water Pollution
• In its largest national survey, USGS found pesticides above levels of concern in 87% of urban monitoring sites.
• Chorpyrifos and diazinon have been replaced with pyrethroids which are now being found in urban creek sediments at levels of concern. (Environ Sci Technol)
• “The dominant sources of these pyrethroids are from structural pest control applications…”

Health effects of mis-use
• Are mis-used...intentionally and unintentionally
• Knowledge of health effects develops over time
Dose makes the poison

Essential vitamins can be toxic in high quantities e.g. Vit A.

Pesticides can be present in ppm or ppb in our bodies.

Hormones are active in our bodies in the parts-per-trillion (ppt) range.

Used in accordance with Western cultural demand...we want it all and we want it NOW!

- Pesticide Dependence

- More than 90% of surveyed US residents carry a mixture of pesticides in their bodies. Out of an average of 91 chemical contaminants, 17 are pesticides or pesticide-related compounds. (Centers for Disease Control)

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CAUTION, WARNING, DANGER - Signal word conveys a message to the products handler regarding its acute toxicity.

Illegal Pesticides

Strychnine

Alkaloid

DE & Pyrethrin

Abamectin

Pyriproxyfen

Tres Pasitos

Aldicarb

Miraculous Chalk or Chinese Chalk is harmless to human beings and animals and safe to use.

Deltamethrin

Naphthalene

Malathion

For Use Around Foundations, Outside Buildings, Lawns, Woodpiles, Stored Lumber and Fence Posts

OUTDOOR USE ONLY

Homo sapiens!
Analysis of cord blood samples for 413 chemicals:
- pesticides
- heavy metals
- plastics
- flame retardants

287 were isolated

Average number/newborn = **200** identified chemicals

Lowest = **154**  
Highest = **231**

Effects of **multiple and/or cumulative** exposures to toxicants and their potential synergistic effects are **UNKNOWN**
**Food**

<table>
<thead>
<tr>
<th>Processed Snack Product</th>
<th>Number of Samples Analyzed</th>
<th>Number of Samples Tested</th>
<th>Percent of Samples with Pesticides</th>
<th>Different Pesticides Detected</th>
<th>Total Pesticides Detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produce</td>
<td>694</td>
<td>694</td>
<td>20</td>
<td>13</td>
<td>192</td>
</tr>
<tr>
<td>Snack Mix</td>
<td>475</td>
<td>475</td>
<td>10</td>
<td>16</td>
<td>86</td>
</tr>
<tr>
<td>TOTAL interns</td>
<td>1,169</td>
<td>1,169</td>
<td>30</td>
<td>49</td>
<td>278</td>
</tr>
</tbody>
</table>

**EWG: Pesticides in Baby Food**

Study: 76 jars of baby food from grocery store shelves in Denver, Philadelphia, and San Francisco were analyzed for a panel of pesticide residues:

- 53% had one pesticide
- 18% had two or more pesticides
- Fruits had up to five different pesticide residues

USDA, 2004

**“Organic Diets Significantly Lower Children's Dietary Exposure to Organophosphorus Pesticides”**

Recruited 23 children, 3-11 years old from Seattle, WA, who ate exclusively conventional diets

Urine samples collected for 15 consecutive days

Introduced an organic diet

Samples analyzed for two organophosphorus (OP) metabolites (Malathion & Chlorpyrifos)

**Three Phase Study**

**Phase I: Days 1-3**
Usual Conventional Diet

23/23 children had OP metabolites present

**Phase II: Days 4-8**
Substituted Organic Diet

OP metabolites decreased immediately to an undetectable level

**Phase III: Days 9-15**
Resumed Conventional Diet

OP metabolites detectable immediately after reintroduction of conventional diet

**Conclusion**

“Organic diet provides a dramatic and immediate protective effect against exposure to organophosphorus pesticides that are commonly used in agricultural production.”

**www.foodnews.org**

- 46 popular fruits & vegetables
- Based on analysis of over 100,000 tests for pesticides
- Data obtained by U.S. Government
‘Latency’ & Disease…

Certain diseases, such as cancer, have long latency periods.

The earlier the exposure, the earlier the latency period begins:

Children **have more time** to develop environmentally-triggered diseases with long latency periods.

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Pediatric Acute Lymphoblastic Leukemia and Exposure to Pesticides

Organophosphates have been hypothesized as one of the risk factors for acute lymphoblastic leukemia.

More case mothers (33%) than controls (14%) reported using insecticides in the home.

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The National Academy of Sciences 1993 landmark report *Pesticides in the Diets of Infants and Children* estimates that 50% of lifetime pesticide exposure occurs during the first five years of life.

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“Woman poisoned by garlic spray”

Rosemary oil can cause spontaneous abortion

Pesticides kill, even botanical pesticides can be toxic.

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**CHILDREN ARE NOT LITTLE ADULTS…**

Children are still

1) Growing & 2) Developing

Greater Metabolic Demands
Anatomic & Physiological Differences
Behavior Differences
**Diet & Dietary Requirements are Greater**

Per Unit of Body Weight:

- **Children eat more food than an adult**
  - A newborn requires about 140 kcal/kg/day
  - An adult man requires about 43 kcal/kg/day

- A 1 year old infant consumes three times as many calories per unit of body weight than an adult.

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**Fluid Requirements are Greater**

Per Unit of Body Weight:

- **Children drink more fluids than adults**
  - The average newborn consumes about 5 oz of breast milk or formula per kilogram of body weight.
  - For the average adult male, this is equivalent to drinking 30 12 oz. cans of soda per day!

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**Oxygen Requirements are Greater**

Per Unit of Body Weight:

- **Children breathe more air than adults**
  - Newborn: 60 breaths/min. > Child 1-4 years old: 35 breaths/min. > Adult: 20 breaths/min.
  - A newborn's minute ventilation is approximately 400 mL/min/kg
  - An adult's minute ventilation is approximately 150 mL/min/kg

- The breathing zone for a child depends on their height and mobility...

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**Anatomy & Physiology Differences: Distribution & Clearance of Toxins are Different**

- Children have:
  - Higher proportion of Total Body Water/kg
  - Less body fat/kg
  - Higher circulating levels of lipophilic pesticides

- Renal clearance varies by age
- May lead to higher levels of toxins or their metabolites

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**Anatomy & Physiology Differences:**

- **Organs & tissues (including the central nervous system, kidneys, liver, lungs, eyes, reproductive system) continue to differentiate and mature throughout infancy, childhood, and, in some cases, adolescence...**

- **Differentiating tissues are often the MOST susceptible to toxic insult**

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**Example: The Developing Brain...**

- Neuronal development, migration, and myelination occur rapidly during the first 2 years of life
- The blood-brain barrier is ‘leaky’, allowing chemicals access to the brain
- The brain continues to markedly develop and grow throughout childhood and adolescence

- Disruption of this process can have profound effects on essential elements of development
What can you do?

- PPE
- Use every pesticide knowing science changes
- Become change agents for IPM

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Use pesticides only when necessary & be selective when you choose a product

HAZARD = Toxicity x Exposure

risk; the potential for injury
the capacity of a pesticide to cause injury
the risk of a pesticide contacting or entering the body

High toxicity, Low exposure risk

Low toxicity, High exposure risk

How do pesticides enter the body?

- Skin (dermal)
- Lungs (inhalation)
- Mouth (oral)
- Eyes

97% of all body exposure during spraying is by skin contact!

Different parts of the body vary in their ability to absorb pesticides.

- Scalp 32%
- Ear Canal 40%
- Abdomen 18%
- Genital Area 100%
- Ball of Foot 13%

Greater dermal absorption

- Warm, moist areas: groin, armpits, head, neck
- Cuts, abrasions, and rashes
- Pesticide formulations affect absorption

Percent Dose Absorbed
Chemical-parathion Melbach 1974
Routes of Entry: Lungs  
(inhalation)

Inhalation exposure can occur:
• When using Wettable powders  Dusts  Gases, vapors  Sprays  
• While mixing and loading  
• During applications

Protect yourself from inhalation exposure!

Fumigants are active as gases!

Routes of Entry: Eyes

Eyes are able to absorb surprisingly large amounts of chemical

This is not an effective respirator…

THE END