Health Effects of Pesticides

Balancing risk
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.

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.
A US Geological Survey review:

- 96% of fish
- 100% of surface water
- 33% of major aquifers contained one or more pesticides

Gilliom et al., 2006
51 studies
1991-2001
• 87% of urban monitoring sites had pesticides above levels of concern.

• Chorpyrifos and diazinon replaced with pyrethroids, now being found in urban creek sediments at levels of concern. (Environ Sci Technol)
The human body is also contaminated:

- Blood and urine
- Average of 91 industrial chemicals.
- A total of 167
- No occupational or residential exposure.
- 17 pesticides or pesticide breakdown products, 76 were carcinogens, 94 neurotoxins, and 79 developmental or reproductive toxins.

Thornton et al., 2002
Mount Sinai School of Medicine
1991-2001
Progress!

- **Bald eagle nesting pairs increase from 417 to 5,748 after DDT ban.**
  - *Fish & Wildlife Service, 2003*

- **Organic diet significantly lowers organophosphates in kids urine.**
  - *Environmental Health Perspectives, 2005*

- **The majority of new pesticide registrations are biopesticides and “reduced-risk” pesticides.**
  - *US EPA Office of Pesticide Programs Annual Reports*
Pesticides

- Insecticides
- Miticides
- Fungicides
- Rodenticides
- Nematicicides
- Herbicides
- Fumigants
- Wood Preservatives
- Growth Disrupters
- Endocrine Disrupters
Do pesticides bug you?

Do Bugs Pester you?

Safe?
Chlorpyrifos (Dursban, Lorsban) End-Use Products Cancellation

ENVIRONMENTAL PROTECTION AGENCY

ACTION: Notice.

[OPP-34203; FRL-6819]

Environmental Protection Agency (EPA).

ACTION: Notice.

CANCELED
EPA’s Mission is to protect human health and the environment. Since 1970, EPA has been working for a cleaner, healthier environment for the American people.
EPA Priority: School IPM

The National Pesticide Program Strategic Goal is to protect public health and the environment by ensuring pesticides and alternatives are safe and available for a healthy America.

• Being an effective gateway to the pesticide market
  • Focus on risk reduction, biopesticide adoption, food safety/trade and public health product efficacy and availability

• Being an effective steward of existing pesticides
  • Focus on a number of issues including: worker protection, enhancement of partnerships and collaborations within EPA and across Federal agencies; and
  • PROMOTE protection through education; leverage voluntary partnerships
Pesticide Environmental Stewardship Program - Mission

PESP is a voluntary program that forms partnerships with pesticide users to reduce the potential health and environmental risks associated with pesticide use and implement pollution prevention strategies.

PESP is guided by the principle that, even in the absence of additional regulatory mandates, the informed actions of pesticide users reduce risk even further. Based on this principle, membership in the program is completely voluntary.

[epa.gov/pesp](http://epa.gov/pesp) soon to be [epa.gov/pestwise](http://epa.gov/pestwise)
CAUTION, WARNING, DANGER - Signal word conveys a message to the products handler regarding its acute toxicity.

- Strychnine Alkaloid
- Pyriproxyfen
- DE & Pyrethrin
- Abamectin
You the consumer need to take an active role to ensure safe use of pesticides.
Illegal Pesticides

Tres Pasitos
Aldicarb

Malathion

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

Naphthalene
52 toddlers
For Use Around Foundations, Outside Buildings, Lawns, Woodpiles, Stored Lumber and Fence Posts
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%
- Forehead: 36%
- Armpit: 64%
- Forearm: 9%
- Palm: 12%
- Back of Hand: 21%

Percent Dose Absorbed
Chemical: parathion
Maibach 1974
Greater dermal absorption

- Warm, moist areas: groin, armpits, head, neck
- Cuts, abrasions, and rashes
- Pesticide formulations affect absorption
Routes of Entry: Lungs (inhalation)

Inhalation exposure can occur:

- When using
  - Wettable powders
  - Dusts
  - Gases, vapors
  - Sprays
- While mixing and loading
- During applications
Fumigants are active as gases!

Protect yourself from inhalation exposure!
This is not an effective respirator...
Routes of Entry: Eyes

Eyes are able to absorb surprisingly large amounts of chemical
Wash your hands!

...before eating, drinking, smoking, or going to the bathroom at breaks!!
BodyBurden
The Pollution in People

BodyBurden
The Pollution in Newborns
A benchmark investigation of industrial chemicals, pollutants, and pesticides in human umbilical cord blood
10 newborn babies

Born in U.S. hospitals

Analysis of cord blood samples for 413 chemicals:

- pesticides
- heavy metals
- plastics
- flame retardants
- stain- and grease-proof coatings

287 were isolated

Average number/newborn = 200 identified chemicals

Lowest = 154

Highest = 231
Perfluorochemicals (PFCs)
Pesticides

Polyaromatic Hydrocarbons
- Heptachlorinated Benzene
- Hexachlorinated Benzene

Perfluorinated Carboxylic Acid
- Heptachlorinated Dioxin
- Hexabrominated Furan

Dichlorinated Naphthalene
- Polybrominated Diphenyl Ethers

Heptabrominated Furan
- Polybrominated Diphenyl Ethers

Polychlorinated Biphenyls
- Tri-chlorinated Naphthalene
- Hexachlorinated Naphthalene
- Heptachlorinated Naphthalene

Brominated Dioxins & Furans
- Hexa-pcb
- Octa-pcb

Chlorinated Dioxins & Furans
- Chlorinated Dioxins
- Chlorinated Furans

Metals (Lead, Mercury, Arsenic, Etc.)
- Polybrominated Diphenyl Ether

Octabrominated Diphenyl Ether
- Heptachlorinated Furan

Deca-pcb
- Heptabrominated Diphenyl Ether

Penta-pcb
- Octa-pcb

Hepta-pcb
- Heptabrominated Diphenyl Ether

Dibrominated Diphenyl Ether
- Pentabrominated Diphenyl Ether

Hexabrominated Furan
- Hexabrominated Diphenyl Ether

Monochlorinated Naphthalene
- Brominated Dioxins

Octachlorinated Dioxin
- Decabrominated Diphenyl Ether

Pentabrominated Diphenyl Ether
- Pentabrominated Diphenyl Ether

Heptabrominated Diphenyl Ether
- Heptabrominated Diphenyl Ether

Tetra-pcb
- Polychlorinated Naphthalenes

Nona-pcb
- Perfluorinated Sulfonate

Heptachlorinated Naphthalene
- Heptachlorinated Dioxin

Pentachlorinated Dioxin
- Penta-pcb

Trichlorinated Naphthalene
- Trichlorinated Naphthalene

Hexachlorinated Dioxin
- Decabrominated Diphenyl Ether

Tri-chlorinated Naphthalene
- Trichlorinated Naphthalene
Effects of multiple and/or cumulative exposures to toxicants and their potential synergistic effects are UNKNOWN
## Food

<table>
<thead>
<tr>
<th>Fruit and Vegetables</th>
<th>Number of Samples Analyzed</th>
<th>Samples with Residues Detected</th>
<th>Percent of Samples with Detections</th>
<th>Different Pesticides Detected</th>
<th>Different Residues Detected</th>
<th>Total Residue Detections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>744</td>
<td>727</td>
<td>98</td>
<td>33</td>
<td>41</td>
<td>2,619</td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>742</td>
<td>402</td>
<td>54</td>
<td>18</td>
<td>24</td>
<td>626</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>185</td>
<td>134</td>
<td>72</td>
<td>4</td>
<td>4</td>
<td>151</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>557</td>
<td>404</td>
<td>73</td>
<td>30</td>
<td>36</td>
<td>1,025</td>
</tr>
<tr>
<td>Grapes</td>
<td>739</td>
<td>574</td>
<td>78</td>
<td>32</td>
<td>39</td>
<td>1,336</td>
</tr>
<tr>
<td>Green Beans</td>
<td>548</td>
<td>387</td>
<td>71</td>
<td>24</td>
<td>28</td>
<td>976</td>
</tr>
<tr>
<td>Lettuce</td>
<td>743</td>
<td>657</td>
<td>88</td>
<td>47</td>
<td>57</td>
<td>1,985</td>
</tr>
<tr>
<td>Oranges</td>
<td>742</td>
<td>654</td>
<td>88</td>
<td>10</td>
<td>12</td>
<td>981</td>
</tr>
<tr>
<td>Pears</td>
<td>741</td>
<td>643</td>
<td>87</td>
<td>31</td>
<td>35</td>
<td>1,309</td>
</tr>
<tr>
<td>Strawberries</td>
<td>731</td>
<td>681</td>
<td>93</td>
<td>28</td>
<td>35</td>
<td>1,996</td>
</tr>
<tr>
<td>Sweet Bell Peppers</td>
<td>558</td>
<td>539</td>
<td>97</td>
<td>43</td>
<td>50</td>
<td>2,282</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>743</td>
<td>461</td>
<td>62</td>
<td>13</td>
<td>14</td>
<td>587</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>744</td>
<td>359</td>
<td>48</td>
<td>17</td>
<td>21</td>
<td>737</td>
</tr>
<tr>
<td>Winter Squash</td>
<td>364</td>
<td>146</td>
<td>40</td>
<td>17</td>
<td>20</td>
<td>217</td>
</tr>
<tr>
<td><strong>TOTAL FRESH</strong></td>
<td><strong>8,881</strong></td>
<td><strong>6,768</strong></td>
<td><strong>76</strong></td>
<td><strong>17</strong></td>
<td><strong>29</strong></td>
<td><strong>16,827</strong></td>
</tr>
</tbody>
</table>

## Processed Fruit and Vegetables:

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Number of Samples Analyzed</th>
<th>Samples with Residues Detected</th>
<th>Percent of Samples with Detections</th>
<th>Different Pesticides Detected</th>
<th>Different Residues Detected</th>
<th>Total Residue Detections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Beans, Canned</td>
<td>185</td>
<td>44</td>
<td>24</td>
<td>5</td>
<td>5</td>
<td>73</td>
</tr>
<tr>
<td>Orange Juice</td>
<td>186</td>
<td>93</td>
<td>50</td>
<td>3</td>
<td>3</td>
<td>94</td>
</tr>
<tr>
<td>Peaches, Canned</td>
<td>743</td>
<td>162</td>
<td>22</td>
<td>3</td>
<td>3</td>
<td>175</td>
</tr>
<tr>
<td>Spinach, Canned</td>
<td>371</td>
<td>300</td>
<td>81</td>
<td>8</td>
<td>8</td>
<td>406</td>
</tr>
<tr>
<td><strong>TOTAL PROCESSED</strong></td>
<td><strong>1,485</strong></td>
<td><strong>599</strong></td>
<td><strong>40</strong></td>
<td><strong>8</strong></td>
<td><strong>8</strong></td>
<td><strong>748</strong></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Processed Grain Product:</th>
<th>Number of Samples Analyzed</th>
<th>Samples with Residues Detected</th>
<th>Percent of Samples with Detections</th>
<th>Different Pesticides Detected</th>
<th>Different Residues Detected</th>
<th>Total Residue Detections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybeans</td>
<td>616</td>
<td>256</td>
<td>42%</td>
<td>8</td>
<td>8</td>
<td>282</td>
</tr>
<tr>
<td>Wheat Flour</td>
<td>725</td>
<td>410</td>
<td>57%</td>
<td>16</td>
<td>16</td>
<td>590</td>
</tr>
<tr>
<td>TOTAL GRAIN</td>
<td>1,341</td>
<td>666</td>
<td>50%</td>
<td>24</td>
<td>24</td>
<td>872</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dairy Product:</th>
<th>Number of Samples Analyzed</th>
<th>Samples with Residues Detected</th>
<th>Percent of Samples with Detections</th>
<th>Different Pesticides Detected</th>
<th>Different Residues Detected</th>
<th>Total Residue Detections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>739</td>
<td>739</td>
<td>100%</td>
<td>12</td>
<td>12</td>
<td>2,129</td>
</tr>
</tbody>
</table>
“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

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

Chensheng Lu, et. al
www.foodnews.org

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

Environmental Working Group
# Shopper’s Guide to Pesticides in Produce

## Highest in Pesticides
These 12 popular fresh fruits and vegetables are consistently the most contaminated with pesticides—buy these organic.

<table>
<thead>
<tr>
<th>Apple</th>
<th>Peaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bell Peppers</td>
<td>Pears</td>
</tr>
<tr>
<td>Celery</td>
<td>Potatoes</td>
</tr>
<tr>
<td>Cherries</td>
<td>Red Raspberries</td>
</tr>
<tr>
<td>Grapes (imported)</td>
<td>Spinach</td>
</tr>
<tr>
<td>Nectarines</td>
<td>Strawberries</td>
</tr>
</tbody>
</table>

## Lowest in Pesticides
These 12 popular fresh fruits and vegetables consistently have the lowest levels of pesticides.

<table>
<thead>
<tr>
<th>Asparagus</th>
<th>Kiwi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avocados</td>
<td>Mangos</td>
</tr>
<tr>
<td>Bananas</td>
<td>Onions</td>
</tr>
<tr>
<td>Broccoli</td>
<td>Papaya</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>Pineapples</td>
</tr>
<tr>
<td>Corn (sweet)</td>
<td>Peas (sweet)</td>
</tr>
</tbody>
</table>

This wallet guide brought to you by: [Environmental Working Group](www.foodnews.org)
 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
Insecticides and Hearing Loss

Herbicides and Childhood Brain Cancer

The etiology of childhood brain cancer remains largely unknown.

Several studies have suggested associations with parental pesticide use.
Herbicides and Childhood Brain Cancer

Pesticides and Parkinson’s Disease

Parkinson’s disease patients who have been exposed to pesticides through their work show elevated rates of disease.

French farm-workers have double the risk for the disease if exposed to pesticides, with a dose-effect for the number of years of exposure.

Looking at insecticides, fungicides and herbicides, farm-workers who used insecticides had > two-fold increase in the risk of Parkinson’s disease.

http://www.beyondpesticides.org/infoservices/pesticidesandyou/Spring%202008/parkinsonscited.pdf
Pesticides and Pancreatic Cancer

*EPTC* is a selective thiocarbamate herbicide

![Odds Ratio Chart]

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.
Groups Warn: New Food Pesticide Dangerous for All Americans (01/03/06)

Job Exposure to Pesticides Linked to Lung Cancer (12/07/04)

French Study Shows Household Pesticides May Increase Leukemia (1/24/06)

Birth Defects in Farm Worker Children Leads to State Investigation (3/15/05)

Study Reveals Toxic Chemicals in Household Dust (03/07/06)

New Study Shows Greater Vulnerability to Pesticides than Predicted (03/07/06)

Farm workers Ask Consumers to Take Action Regarding Pesticide-Parkinson’s Link (12/16/05)

Research Finds Exposure to Low Levels of Pesticides Increases Risk of Cancer (03/20/06)

Researchers Study Impact of Pesticides on Children’s Mental Development (09/02/04)
“Woman poisoned by garlic spray”

Rosemary oil can cause spontaneous abortion

Pesticides kill, even botanical pesticides can be toxic
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...
Children are not Little Adults...

Children are still

1) Growing

&

2) Developing

Greater Metabolic Demands

Anatomic & Physiological Differences

Behavior Differences
Metabolic 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.
Metabolic Differences:
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!

X 30 !!!
Metabolic Differences: Oxygen Requirements are Greater

Per Unit of Body Weight:
Children breath 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 400mL/min/kg

An adult’s minute ventilation is approximately 150mL/min/kg

Children also breath different air than adults!

The breathing zone for an adult is typically 4 to 6 feet above the floor

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

Renal clearance varies by age

May lead to higher levels of toxins or their metabolites
Anatomy & Physiology Differences:
Distribution & Clearance of Toxins are Different

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
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.
Definitive Proof

???
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.
Tobacco Industry

Argues to this day that there is “no conclusive scientific proof” that smoking causes cancer or lung disease.

Sued the Environmental Protection Agency in the mid-1990’s to remove the statement on cigarette packaging that passive smoking can cause cancer.

Does not label packaging exported to other nations because of this ‘lack of proof’.
Effects of **SUBACUTE/CHRONIC** exposure of neurotoxic pesticides on developing neurons are **UNKNOWN**.

**Silent Toxicity**

Effects of **MULTIPLE INTERACTIONS** between neurotoxic pesticides over time on developing neurons are **UNKNOWN**.

**ACUTE**

**ACUTE POISONINGS** with pesticide neurotoxins are commonly encountered & well described.