Environmental Toxins: How Nutrition Can Help

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DISCLOSURE

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OBJECTIVES

At the end of this session, the participant will be able to…

• Identify how Persistent Organic Pollutants (POPs) enter the food supply.

• Identify dietary changes that can decrease the intake of POPs.

• List ways that have been proposed to decrease POP levels.

This site was created:

- to raise awareness about the health and environmental impacts of persistent organic pollutants (POPs),
- to show what actions the United States and some other countries have already taken to address these pollutants, and
- to describe the actions set into motion by the [Stockholm Convention on Persistent Organic Pollutants](https://www.pop-laws.com/stockholm-convention) to address this issue globally.

The site explains the importance of the Stockholm Convention, a legally binding international agreement finalized in 2001. In the Stockholm Convention, participating governments agreed to take actions to reduce or eliminate the production, use, and/or release of certain of these pollutants.

This content was created in 2002 and updated in December 2009.

Contents

- What Are POPs?
- What Domestic Actions Have Been Taken to Control POPs?
- How Do POPs Affect People and Wildlife?
- The Great Lakes: A Story of Trials and Triumphs
- Alaska: POPs in America’s Arctic
- The Stockholm Convention
- Table: The “Dirty Dozen”
- What Has the United States Done to Address POPs Globally?

Resources

A Global Issue
The "Dirty Dozen"

- aldrin
- chlordane
- dichlorodiphenyl trichloroethane (DDT)
- dieldrin
- endrin
- heptachlor
- hexachlorobenzene
- mirex
- toxaphene
- polychlorinated biphenyls (PCBs)
- polychlorinated dibenzo-p-dioxins (dioxins)
- polychlorinated dibenzofurans (furans)

1–Intentionally Produced.
2–Unintentionally Produced – Result from some industrial processes and combustion.

For more information, see table below.
### II. EXPOSURE MEDIA AND POTENTIAL FOR CHILDREN’S EXPOSURE

<table>
<thead>
<tr>
<th>Exposure Media</th>
<th>Relative Potential for Children’s Exposure&lt;sup&gt;1,3&lt;/sup&gt;</th>
<th>Basis&lt;sup&gt;4&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td>Higher</td>
<td>Diet is a major source of exposure. PCBs can be found in fish, meat, and dairy products, and tend to bioaccumulate in animal fats. PCBs have also been detected in human breast milk (see Considerations for Decision Makers).</td>
</tr>
<tr>
<td>Sediment</td>
<td>Medium</td>
<td>PCBs can remain in sediment for many years, and the PCBs that persist are often called the “weathered” PCBs. Persistent weathered PCBs often contain more highly chlorinated PCBs (with 6-9 chlorine atoms) than PCBs recently released into the environment. Highly chlorinated PCBs may be more toxic than PCBs with lower chlorination. PCBs in sediment can bioaccumulate in fish.</td>
</tr>
<tr>
<td>Soil</td>
<td>Medium</td>
<td>PCBs can remain in soil for many years with limited degradation.</td>
</tr>
<tr>
<td>Ambient Air</td>
<td>Lower</td>
<td>Generally, low levels of PCBs are found in ambient air; in cases of disruption or movement of PCB-containing materials, PCBs might be released to nearby air.</td>
</tr>
<tr>
<td>Indoor Air</td>
<td>Lower</td>
<td>Generally, low levels of PCBs are found in indoor air.</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Lower</td>
<td>Most PCBs partition to sediment, solids, or oils in water, not the water column; generally, low levels of PCBs have been found in surface water.</td>
</tr>
<tr>
<td>Drinking Water</td>
<td>Lower</td>
<td>PCB contamination of drinking water can be a concern in areas close to sites contaminated with PCBs.</td>
</tr>
</tbody>
</table>
A total of **12,563 food and feed samples** collected in the period 1995-2008 from 18 EU Member States. In food, the highest mean contamination level was observed in fish and fish derived products, followed by eggs, milk and their products, and meat and meat products. The lowest contamination was observed in foods of plant origin. A similar pattern was observed in feed where high contamination was reported in feed containing fish derived products and comparatively very low levels in feed of plant or mineral origin.
POPs are ubiquitous microcontaminants that are lipid soluble and bio-accumulate in stored fat.
### POPs are in People

#### Serum 2,2',4,4',5,6'-Hexabromodiphenyl ether (BDE 154) (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (in ng/g of lipid or parts per billion on a lipid-weight basis) for the U.S. population from the National Health and Nutrition Examination Survey.

<table>
<thead>
<tr>
<th>Survey years</th>
<th>Geometric mean (95% conf. interval)</th>
<th>Selected percentiles (95% confidence interval)</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>&lt; LOD</td>
<td>0.90 (0.80-1.10)</td>
<td>2.10 (1.70-2.70)</td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-19 years</td>
<td>&lt; LOD</td>
<td>1.20 (1.00-1.40)</td>
<td>2.70 (2.00-3.00)</td>
</tr>
<tr>
<td>20 years and older</td>
<td>&lt; LOD</td>
<td>0.90 (0.80-1.10)</td>
<td>2.00 (1.60-2.80)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>&lt; LOD</td>
<td>1.00 (0.80-1.20)</td>
<td>2.30 (1.80-3.00)</td>
</tr>
<tr>
<td>Females</td>
<td>&lt; LOD</td>
<td>0.90 (0.80-1.00)</td>
<td>1.80 (1.40-2.80)</td>
</tr>
<tr>
<td><strong>Race/ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexican Americans</td>
<td>&lt; LOD</td>
<td>1.00 (0.90-1.10)</td>
<td>1.80 (1.40-2.30)</td>
</tr>
<tr>
<td>Non-Hispanic blacks</td>
<td>&lt; LOD</td>
<td>1.20 (0.90-1.40)</td>
<td>2.70 (2.30-4.40)</td>
</tr>
<tr>
<td>Non-Hispanic whites</td>
<td>&lt; LOD</td>
<td>0.90 (0.80-1.10)</td>
<td>2.00 (1.50-2.80)</td>
</tr>
</tbody>
</table>

*Limit of detection (LOD, see Data Analysis section) for Survey year 03-04 is 0.3.  
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.

Updated March 2015
‘The general population is exposed to sufficient POPs, both in terms of concentration and diversity, to induce metabolic disorders. This situation should attract the greatest attention from the public health and governmental authorities.’
Associations of POPs and Disease

- Thyroid
- Diabetes
- Metabolic disorders
- Fertility
- Pediatric development
- Reduced skeletal capacity
- Cardiovascular diseases
- Cancer
Nutrition Can Modulate the Toxicity of Environmental Pollutants: Implications in Risk Assessment and Human Health

Paper by: Bernhard Hennig, Ph.D., R.D., et. al.

Nutrition may serve as an agonist (high-fat, high-toxin foods) or an antagonist (rich in antioxidants and detoxification nutrients, and low in toxins).

Food choices may help explain the large variability observed in human risk assessment.

Nutrition Interventions may be a powerful approach to reduce disease risk associated with environmental toxic insults.
Integrative and Functional Recommendations

1. Assess possible level of exposure
2. Reduce intake of and exposure to toxins
3. Increase excretion of fat-soluble persistent toxins
4. Support detoxification pathways
5. Provide anti-inflammatory support
1. Assess possible level of exposure

\[ CH^2OPD^2 \]

- C ommunity
- H ome
- H obby
- O ccupation
- P ersonal
- D iet
- D rugs
Testing environmental toxins, such as PCBs is done in research and by some clinicians

Adipose tissue concentrations are an indicator of chronic exposure to PCBs, while serum levels are a good predictor of ongoing exposure and the mobilization of PCBs stored in fatty tissues.

Body mass index was found to be an important modifier of these associations.
2. Reduce intake of and exposure to toxins:

- Food preparation methods that reduce fat in the food you eat may help to reduce exposure.
  - Trimming fat and broiling, baking, or grilling allow fat to cook off.
  - Washing food cannot reduce toxin levels.
2. Reduce intake of and exposure to toxins:

- Reduce intake of higher fat, animal based foods, fish, meat, dairy, eggs.
  - Opt for low-fat, lean, organic options
Vegans and vegetarians were found to have lower toxin levels

Determinants of serum concentrations of organochlorine compounds in Swedish pregnant women: a cross-sectional study.

In study 1, plasma concentrations of five OC compounds (aroclor 1260 and PCB 99, PCB 138, PCB 153 and PCB 180) were significantly lower in vegans compared with omnivores.

In conclusion, there was a trend toward lesser contamination in vegans than in omnivores.

CONCLUSION: Although some of the associations could be caused by unknown personal characteristics confounding the results, our findings suggest that exposures to organochlorine compounds during childhood and adolescence influence the body burdens of the compounds during pregnancy.
2. Reduce intake of and exposure to toxins:

- Reduce intake of fish higher in POPS (PCB)
  - fish that are bottom feeders, such as catfish.
  - large freshwater fish that are higher up on the food chain are likely to have higher PCB levels.
  - farmed salmon PCBs thought to come from the fish feed.
    - Choose wild Alaskan salmon and choose sustainably farmed salmon
2. Reduce intake of and exposure to toxins:

Weight loss can result in a significant release of persistent organic toxins,\(^1,2\) that may lead to an increase of symptoms, which may contribute to unsuccessful weight loss attempts.

3. Increase excretion of POPs

Fat Binders: proposed POP reduction

- Green tea
- Chlorella
- Fiber
- Olean (Olestra) products
- Cholesterol lowering (Intern Med. 2004 Sep;43(9):792-5.)
  - Bile-acid sequestrants
  - cholestyramine (CSM)
Enterohepatic Circulation

Bile acids enter the intestinal lumen, help to emulsify and solubilize dietary lipids and their digestion products, and then are actively reabsorbed in the distal part of the small intestine. This reabsorption is an efficient process that returns 90–95% of luminal bile acids back to the liver and ultimately to bile. This recycling conserves the body’s bile-acid pool, with only a small portion being excreted through each of approximately 12 cycles per day.
3. Increase excretion of POPs: Polyphenols: Green Tea

- Green tea consumption has been shown to lower plasma levels of lipids and lipid-soluble compounds, including lipophilic POPs, and to enhance fecal excretion.
3. Increase excretion of POPs: *Chlorella*

- Chlorella is a genus of single-cell green algae, from the sea belonging to the phylum Chlorophyta.
- It has been proposed to aid in facilitating detoxification and preventing absorption of adverse compounds.
Other animal studies have suggested that *Chlorella* may be useful in inhibiting the absorption of dioxins via food and the reabsorption of dioxins stored already in the body in the intestinal tract, thus preventing accumulation of dioxins within the body.
3. Increase Excretion of POPs: Bile-acid Sequestrants -

- Limited research suggests bile acid sequestrants: cholestyramine (CSM) therapy may facilitate gastrointestinal elimination of some perfluorinated compounds from the human body.

- Serum levels of all perfluorinated subsequently declined after regular use of CSM.

- Further study is required but suggests that CSM therapy may facilitate gastrointestinal elimination of some perfluorinated from the human body.

• This study in mice found that combined dietary olestra and caloric restriction caused a 30-fold increase in the rate of excretion of 14C relative to an ad libitum diet or a reduced caloric diet alone.

• Inclusion of olestra in the diet resulted in interruption of enterohepatic circulation of hexachlorobenzene (HCB) and reduction in all tissues even during the periods of caloric restriction.

• The authors suggest that an appropriate regimen for therapeutic removal of lipophilic toxins is the combination of caloric restriction and the interruption of enterohepatic circulation with a nonabsorbable fat.
3. Increase excretion of POPs: Sweat

Limited research has shown saunas or exercise to decrease POPs

- Exercise
- Saunas

4. Support Detoxification Pathways

- Provide nutrient co-factors: B6, Mg, B12
- Support proper excretion: good gut health
- Support glutathione
  - sulfur-containing foods (e.g., eggs, brassicas and alliums)
  - supplements such as N-acetylcysteine, glycine
Two Major Pathways of Detoxification

**Nutrient Cofactors**
- riboflavin
- niacin
- pyridoxine
- vitamin B12
- BCAA
- flavinoids
- magnesium
- selenium

**Conjugation**
- Sulfation
- Glucuronidation
- Acetylation
- AA Conjugation:
  - Glycine
  - Taurine
  - Glutamine
  - Arginine
  - Methylation

**Antioxidants**

**CYP450**

**Oxidative Stress**

**Elimination**
5. Support anti-inflammatory nutrients

- Cell research suggests that nutrients can modulate PCB-induced oxidative stress and endothelial toxicity.
  - Decrease
    - Vitamin E
    - Flavinoids
    - Quercetin
  - Increase
    - Linoleic acid
- Such studies may be used to develop dietary recommendations and nutritional interventions.

References:

Quercetin blocks pro-inflammatory responses induced by PCBs

• To determine the effects of quercetin on PCB-mediated induction of cell adhesion molecules, endothelial cells were treated with quercetin and/or PCB77.

• Overall, the results from the study suggested that quercetin, may be protective against PCB-induced inflammation in vascular endothelial cells.
6. Stop aging

Age was positively and most strongly associated with tissue PCB levels, perhaps representing long-term dietary intake and the complex interplay of absorption, metabolism, distribution, and excretion.
Conclusion

The concept that nutrition recommendations and treatment may modify or ameliorate the toxicity of environmental chemicals is provocative and warrants further study.

Promotion of healthy eating and lifestyle habits may include the notification that they may be lower in environmental toxins.
END