

Summary of Epidemiological and Environmental Toxicology Research in the Great Lakes Region

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Presentation Summary

- Epidemiology
 - Human health impacts from exposure to PTSs
- Environmental Toxicology
 - Effects of exposure to PTSs on other biota (i.e. fish and wildlife)

Toxicology

- EPA - The study of harmful interactions between chemical, physical, or biological agents and biological systems.¹
- In the biological continuum from molecules to communities, processes at one level have their mechanistic origins in the preceding level and express their consequences in the next level.²

¹ - US EPA

² - Canadian Wildlife Service

Toxicology Research

- Seek to link exposure to effect, often with limited information
- Must determine
 - Contaminant/s fate and transport properties.
 - Dose of contaminant/s and time of exposure that leads to some measure of effect.

Epidemiology Research

Human Health and Exposure to Great Lakes PTSs

- Three major routes
 - Drinking Water (<1%)
 - Air (5-10%)
 - Food consumption – primarily fish (80-90%)

Source - Birmingham *et al.* 1989; Newhook 1988

What Have Past Studies Shown?¹

- Increased body burdens of toxic substances in study populations (often classified as “at risk”)
- Neurobehavioral and developmental deficits occur
- Reproductive function may be disrupted
- Other systemic effects
- People living near AOCs at greater risk

¹ – from Johnson *et al.* 1998

Limitations of these Studies

- Determining causality
 - Statistical limitations
 - Controlling for other factors affecting health
- Comparing studies difficult
 - Different analytical methods and study designs

Current Areas of Research

- Characterization of exposure and determination of the profiles and levels of Great Lakes contaminants in human tissues and fluids
- Identification of sensitive and specific human reproductive end points
- Determination of the short- and long-term risk/s of adverse health effects in the children of exposed parent
- Feasibility of establishing registries and/or surveillance cohorts in the Great Lakes

Environmental Toxicology Research

What Have Past Studies Shown?

- Observations¹
 - Population
 - Individual
 - Cellular/sub-cellular
- Focus
 - Measuring environmental effects in the field and measuring toxicity in a laboratory situation and trying to extrapolate to what is going on in the environment

¹ – from Johnson *et al.* 1998

Changing Focus

- Efforts to measure effects at smaller levels of biological organization – i.e. sublethal effects
- Use of biomarkers to detect abnormalities at the organ, tissue, cellular, or subcellular level
 - Excellent early warning signs
 - Provide insight into response mechanisms

Current Areas of Research

- Measuring exposure to environmental estrogens (laboratory and field)
- Measuring exposures to PBDEs and fluorinated surfactants (laboratory and field)
- Research related to chemical risk assessment such as determining toxicological pathways for use in developing QSARs

Current Areas of Research

- Research to determine the fate, transport, and food web accumulation of contaminants
- Developing and improving mechanistic models of water, sediment, biota interactions
- Development of quantitative relationships between chemical and non-chemical stressors and the responses of freshwater ecosystems and aquatic life and wildlife species

Summary

- Despite limitations and weaknesses of individual research efforts, the collective “weight of evidence” from the findings across disciplines indicates PTSs, such as some PCBs and DLCs found in Great Lakes fish can cause neurobehavioral, developmental, and reproductive problems.

Some Current Gaps

- Effects of multiple stressors
- Research to predict bioavailability and subsequently exposure remains a critical research area particularly for sediment associated contaminants.
- Qualitative and quantitative ability of organisms to biotransform compounds
- Effects of contaminants in mixture including those at low level
- The ability to predict chronic effects (such as reproduction and endocrine disruption)
- Prediction of the impact of new contaminants
- Prediction of contaminant exposure over large portions of the Great Lakes ecosystem remains limited to a few well studied compounds in areas that have been thoroughly studied.
- relate biochemical marker response to toxicity at the individual or population level.

Some Current Gaps

- Research to predict bioavailability and subsequently exposure remains a critical research area particularly for sediment associated contaminants.
- Research on the qualitative and quantitative ability of organisms to biotransform compounds remains unpredictable.
- The ability to determine effects of contaminants in mixture remains unpredictable.
- The ability to predict chronic effects including such endpoints such as reproduction and endocrine disruption are problematic.
- There is limited ability to predict the impact of low level exposures to multiple contaminants.
- Prediction of the impact of new contaminants, particularly when first discovered in the environment, cannot be made with any accuracy.
- Prediction of contaminant exposure over large portions of the Great Lakes ecosystem remains limited to a few well studied compounds in areas that have been thoroughly studied.
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