Recreational Exposure to Microcystins During Algal Blooms in Small Lakes

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Overview

- Define harmful algal blooms (HABs)
- HABs: Epidemiologic studies

Harmful Algal Blooms (HABs)

- Microscopic algae
  - Dinoflagellates
  - Diatoms
  - Blue-green algae
- Bloom is a proliferation of these organisms
- “Harm”
  - Toxin production
  - Oxygen deprivation
  - Light deprivation

Algal Toxins and Human Health: Marine Toxins

- Shellfish Poisonings
  - Diarrheic Shellfish Poisoning (DSP)
  - Neurotoxic Shellfish Poisoning (NSP)
  - Paralytic Shellfish Poisoning (PSP)
  - Amnesic Shellfish Poisoning (ASP)
- Ciguatera fish poisoning
- Fugu (Pufferfish) poisoning (tetrodotoxin)
- Pufferfish poisoning (saxitoxin)
- Respiratory illness (brevetoxins)

Algal Toxins and Human Health: Cyanobacterial Toxins

- Skin rashes, allergic reactions
- Neurologic effects
- Liver damage
- Genotoxic
- Tumor promoting

What do we know?

- Algal toxins are some of the most potent natural toxins known
- Algal toxins can be in our drinking and recreational waters
- They can cause harm to animals, the local ecosystems, and sometimes to people

What are the important Public Health questions?

- Are people exposed to toxins when they use the lakes for recreation during algal blooms?
- What amounts of algal toxins in drinking and recreational waters do we need to worry about?

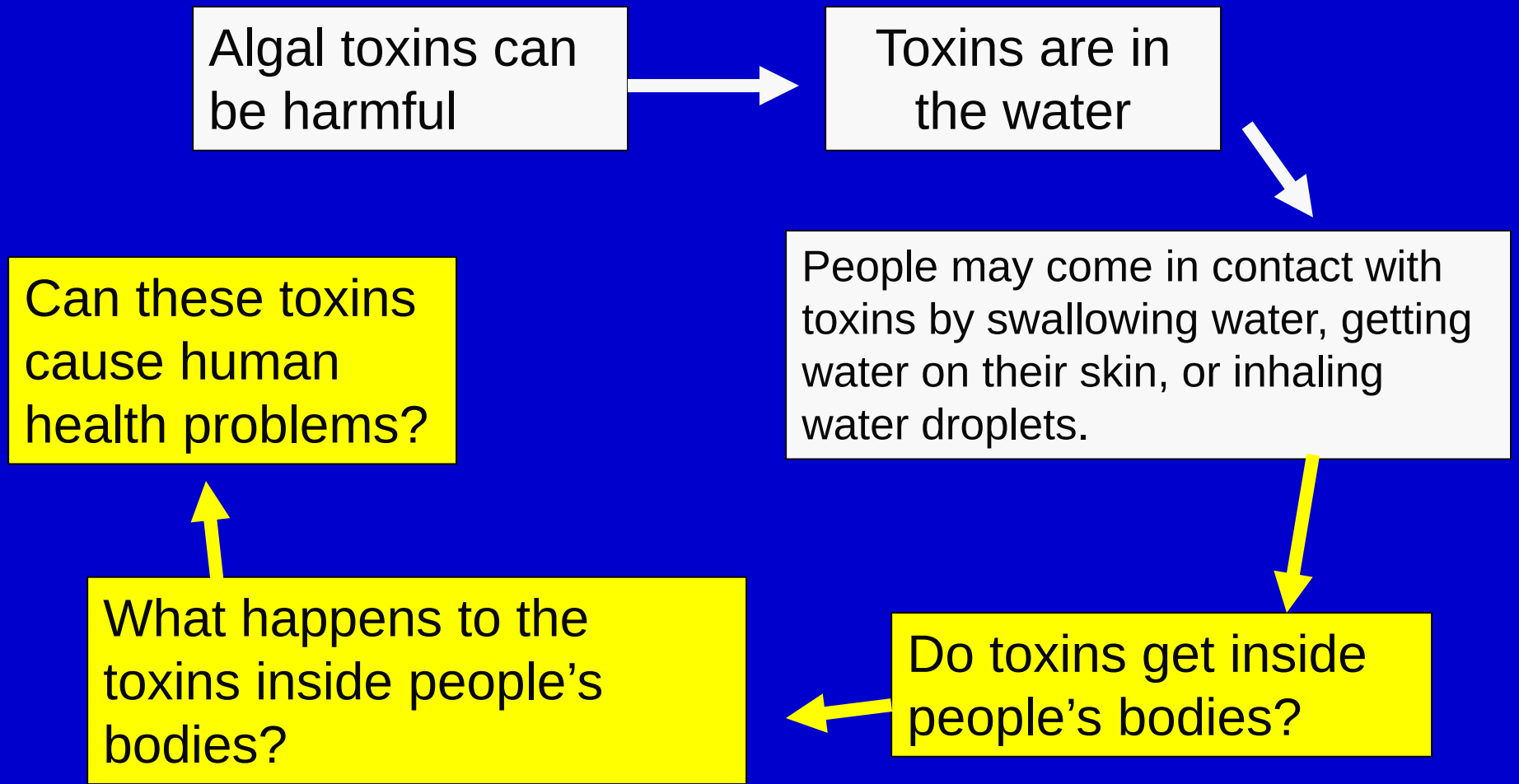
There is little guidance to address this question

- No U.S. Federal (EPA) guidelines or regulations for drinking water or recreational waters for cyanobacteria or their toxins.

World Health Organization (WHO) guidelines

- The guideline for lifetime exposure in *drinking water* is 1 µg/liter.
- The guideline for recreational waters is based on estimated health risk.
  - Low risk — 4 µg/liter
  - Moderate risk — 20 µg/liter
  - High risk — Scums on surface

What we know about toxins in recreational water and human health effects

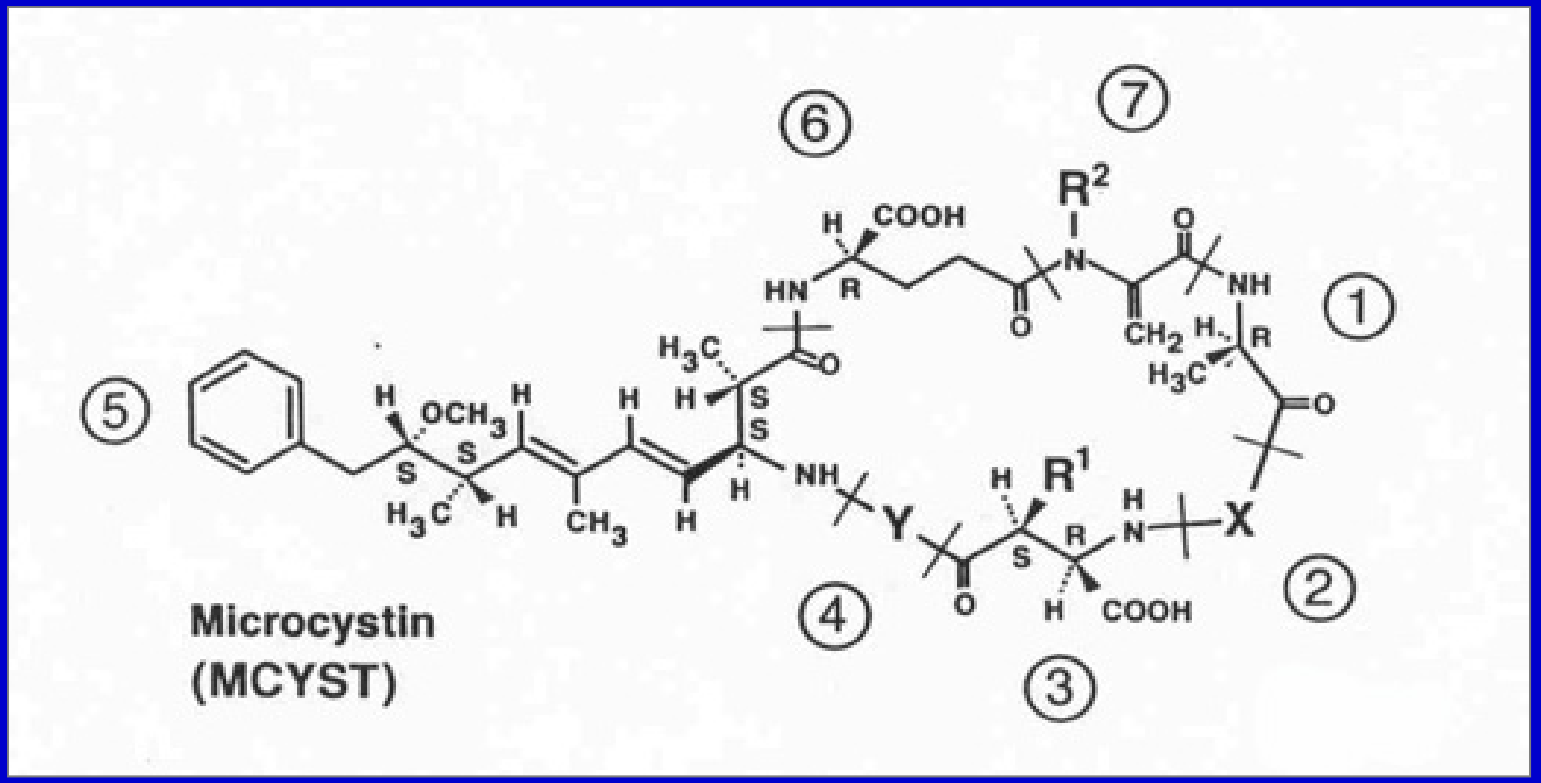


Exposure to Microcystins in Recreational Waters

States must develop their own criteria

- Drinking water
  - Oregon state limit for microcystins in finished drinking water is 1 µg/liter
- Recreational waters
  - California guideline for warning people about recreational exposure is 8 µg/liter.
  - Washington state provisional guideline for recreational waters is 6 µg/liter.

Hepatotoxic Cyclic Peptides



Collaborators

- National Center for Environmental Health, CDC
- National Center for Infectious Diseases, CDC
- Mote Marine Laboratory
- Greenwater Laboratory
- Lovelace Respiratory Research Institute
- Wright State University
- Other Federal Agencies (NOAA)
- State and local public health agencies
- Officials or others at study site

Epidemiology Study Design

- Study population
  - Planning recreational activities in lake with a HAB (exposed)
  - Planning recreational activities in lake with no HAB (control)
- Recruited in person

Environmental Data Collection

- Water samples (24)
  - Viruses
  - Water quality
  - Algal taxonomy
  - Microcystins

Environmental Data Collection: New Methods

- Air samples
  - 3 High-volume
    - Particle size
    - Mircocystins
- 50 personal air samples
  - Microcystins

Health-related Data Collection

- Recruited 104 people
- Questionnaires
  - Pre-exposure
  - Post-exposure
  - Follow-up (7-10 days later)
- Post exposure plasma samples
  - Mircocystins

Outcome Measures

- Compare plasma levels of microcystins in control and exposed groups
- Compare symptom reports

Results

Parameter	**Unexposed** **N = 7**	**Exposed** **N = 97**
Microcystin in water (µg/L)	< LOD LOD = 0.15	3-5
Microcystins in air (ng/m^3)	NA	< LOD – 0.14 LOD = 0.0037
Microcystins in blood (µg/L)	<LOD LOD = 0.147 µg/L	< LOD
Symptoms	No change	No change

Exposure to Microcystins in Recreational Waters: Part 2

Collaborators

- National Center for Environmental Health, CDC
- California Department of Health
- Siskiyou County
- Mote Marine Laboratory
- Greenwater Laboratory
- National Center for Infectious Diseases, CDC
- Lovelace Respiratory Research Institute
- Karuk Tribe
- Pacific Corporation

Health-Related Data Collection

- Added nasal swabs
  - Microcystins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Results

Parameter	**Unexposed** **N = 7**	**Exposed** **N = 88**
Microcystin in water (µg/L) (total microcystins)	< LOD	23 – 357
Microcystins in air (ng/m^3)	NA	0.2 – 0.4
Microcystins in blood	<LOD	<LOD
Microcystins on nasal swabs	**NA**	**< LOD - 0.4 ng**
Symptoms	No change	No change

What have we learned about microcystin exposure?

- Aerosols generated in lakes with blue-green blooms producing microcystins contain measurable concentrations of this toxin in the water, in the air and on nasal swabs
  - Potential for exposure
  - Potential for public health impact

What's Next?

- Refine exposure assessments
- Develop biological markers for very low dose exposures (acute and chronic)
- Laboratory studies to assess effects at the molecular level


WARNING
LIFEGUARD, BACTERIOLOGIST, MICROBIOLOGIST, + TOXICOLOGIST NOT ON DUTY
SWIM AT YOUR OWN RISK