Eating Fish

Maximizing Benefits & Minimizing Risks

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Michigan State University

Funding - Great Lakes Restoration Initiative EPA GL-00E00461
No commercial conflicts of interest
Objectives

• Benefits of Eating Fish/Fish oil
• Risks of Eating Fish/Fish oil
• Store Bought vs. Recreational Caught Fish
• Talking to Patients
• Available Resources
AHA 2006 Diet and Lifestyle Recommendations for Cardiovascular Disease Risk Reduction

- Balance calorie intake and physical activity to achieve or maintain a healthy body weight.
- Consume a diet rich in vegetables and fruits.
- Choose whole-grain, high-fiber foods.
- Consume fish, especially oily fish, at least twice a week.
- Limit your intake of saturated fat to <7% of energy, trans fat to <1% of energy and cholesterol to <300 mg per day.
- Minimize your intake of beverages and foods with added sugars.
- Choose and prepare foods with little or no salt.
- If you consume alcohol, do so in moderation.
- When you eat food that is prepared outside of the home, follow the AHA Diet and Lifestyle Recommendations.

(Circulation 2006; 114:82-96)
<table>
<thead>
<tr>
<th>FAMILY</th>
<th>FATTY ACIDS</th>
<th>FORMULA</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omega-9</td>
<td>Oleic acid</td>
<td>C18:1</td>
<td>Most vegetable oils (canola, olive); animal fats</td>
</tr>
<tr>
<td>Omega-6</td>
<td>Linolenic acid</td>
<td>C18:2</td>
<td>Many vegetable oils (corn, safflower, soybean)</td>
</tr>
<tr>
<td></td>
<td>Arachidonic acid</td>
<td>C20:4</td>
<td>Poultry, meats</td>
</tr>
<tr>
<td>Omega-3</td>
<td>α-linolenic acid</td>
<td>C18:3</td>
<td>Selected vegetable oil (flaxseed, canola)</td>
</tr>
<tr>
<td></td>
<td>EPA</td>
<td>C20:5</td>
<td>Marine oils and fish</td>
</tr>
<tr>
<td></td>
<td>DHA</td>
<td>C22:6</td>
<td>Marine oils and fish</td>
</tr>
<tr>
<td>Saturated</td>
<td>Palmitic acid</td>
<td>C16:0</td>
<td>Animal and vegetable fats</td>
</tr>
<tr>
<td>fats</td>
<td>Stearic acid</td>
<td>C18:0</td>
<td>Butter, palm oil, kernel oil, coconut oil, and animal fats</td>
</tr>
</tbody>
</table>

DHA = docosahexaenoic acid; EPA = eicosapentaenoic acid.  
*(J Am Coll Card 2009;54:585-594)*
<table>
<thead>
<tr>
<th>Oily Fish</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon</td>
<td>Swordfish</td>
</tr>
<tr>
<td>Trout</td>
<td>Bloater</td>
</tr>
<tr>
<td>Mackerel</td>
<td>Cacha</td>
</tr>
<tr>
<td>Herring</td>
<td>Carp</td>
</tr>
<tr>
<td>Sardines</td>
<td>Hilsa</td>
</tr>
<tr>
<td>Pilchards</td>
<td>Jack Fish</td>
</tr>
<tr>
<td>Kipper</td>
<td>Katla</td>
</tr>
<tr>
<td>Eel</td>
<td>Orange Roughy</td>
</tr>
<tr>
<td>Whitebait</td>
<td>Pangas</td>
</tr>
<tr>
<td>Tuna (fresh only)</td>
<td>Sprats</td>
</tr>
<tr>
<td>Anchovies</td>
<td></td>
</tr>
</tbody>
</table>
Potential EPA and DHA Effects

- Anti-arrhythmic effects
- Improvements in autonomic function
- Decreased platelet aggregation
- Vasodilation
- Decreased blood pressure
- Anti-inflammatory effects
- Improvements in endothelial function
- Plaque stabilization
- Reduced atherosclerosis
- Reduced free fatty acids and triglycerides
- Up-regulated adiponectin synthesis
- Reduced collagen deposition

*(J Am Coll Card 2009;54:585-594)*
Relative risk of sudden cardiac death (SCD) according to baseline blood levels of omega-3 fatty acids as percentage of total fatty acids.

(J Am Coll Card 2009;54:585-594 (Data from Albert et al. originally printed Lee et al.))
EPA in Primary Prevention 1.8 g/day Reduced the Incidence of Major Adverse Coronary Events in the JELIS (Japan EPA Lipid Intervention Study) Trial by 19%
Fish Oil And Post-mi Prognosis Early Benefit of Omega-3 Polyunsaturated Fatty Acid Therapy on Total Mortality, Sudden Death, Coronary Heart Disease Mortality, and Cardiovascular Mortality

A. Total Mortality

B. Sudden Death

C. CHD Mortality

D. Cardiovascular Mortality

(J Am Coll Card 2009;54:585-594 (Reprinted, with permission, from Marchioli et al.))
### Fish Oil Dosing and Cardiovascular Impact

#### Dietary doses

- **Relative strength of effect**

#### Supplemental doses

<table>
<thead>
<tr>
<th>Clinical effect</th>
<th>Time course to alter clinical events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiarrhythmia</td>
<td>Weeks</td>
</tr>
<tr>
<td>Triglyceride lowering</td>
<td>Months to years</td>
</tr>
<tr>
<td>Heart rate lowering</td>
<td>Months</td>
</tr>
<tr>
<td>BP lowering</td>
<td>Months to years</td>
</tr>
<tr>
<td>Antithrombosis</td>
<td>Weeks</td>
</tr>
</tbody>
</table>

#### EPA + DHA intake (mg/d)

- 0
- 500
- 1000
- 1500
- 2000
- 2500

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(J Am Coll Card 2009;54:585-594 (Reprinted, with permission, from Mozaffarian and Rimm))
Omega-3 Fatty Acids and Secondary Prevention of Cardiovascular Disease - Is it Just a Fish Tale?

Meta Analysis of Randomized Double-Blind Placebo-Controlled Trials 14 Studies supplemental Omega-3 Fatty Acids

Archives Internal Med 2012; 172:694-696

- More recent studies - no effect Omega-3
  More cardio protective Tx: Statin use 85-94% vs. 23-29%

- Maybe only effective primary prevention

- Questioned exclusion 2 key Positive Studies
**n-3 Fatty Acids and Cardiovascular Outcomes in Patients with Dysglycemia**

Diabetes or high risk diabetes & increased Risk CV events, n=12,536

No Protective Effect - Death

*(NEJM 2012; 367:309-317)*

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**n-3 Fatty Acids and Cardiovascular Events after Myocardial Infarction**

S/P MI, n= 4,837

No Protective Effect – Death and CV Events

*(NEJM 2010;363:2015-2026)*

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Possible Reasons for Negative Results

- Positive studies < 3 months s/p MI
- More cardio protective therapy in current studies
- Not effective in diabetes or those increased risk diabetes
## Summary of Cardiovascular Benefits of Ingesting Fish/Fish Oil

<table>
<thead>
<tr>
<th>Category</th>
<th>Benefit Description</th>
<th>Recommended Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Prevention</strong></td>
<td>19% Reduction in CV Events (0.5 gm/day)</td>
<td></td>
</tr>
<tr>
<td><strong>S/P MI</strong></td>
<td>23% Reduction (0.5 gm/day)</td>
<td></td>
</tr>
<tr>
<td><strong>Arrhythmias</strong></td>
<td>30% Reduction Risk of Atrial FIB (0.5 gm/day)</td>
<td></td>
</tr>
<tr>
<td><strong>CHF</strong></td>
<td>5-10% Reduction Mortality (0.5 gm/day)</td>
<td></td>
</tr>
<tr>
<td><strong>Triglycerides</strong></td>
<td>30-40% Reduction (FDA Approved 4gm/day)</td>
<td></td>
</tr>
</tbody>
</table>
Cognitive Decline and Dementia

- Randomized/Control studies - negative both in cognitively normal and those with dementia
  
  Brit J Nutrition 2012
  Cochrane Data Base System Review 2012
Childhood Cognitive & Visual Development

DHA Accumulates Second Half of Pregnancy

- Neural Cortex & Retinal Membrane Synopses

Observational Studies - Positive Association

- High-Grade Stereoacuity
- Vocabulary Comprehension
- Receptive Vocabulary
- Verbal Intelligence Quotient
- Higher Cognitive Scores
Gestational Benefits

Benefits to Mother
- Reduce Pre-Eclampsia - 7.5 fold decrease
- Reduce Incidence Pre term delivery - 1.9% vs. 7.1%
- Reduce Post-Partum Depression

Benefits to Child
- Reduction allergic disease
- Improved eye and hand coordination
- Enhanced cognitive and behavioral function
- Improved sleep behavior
- Decreased risk of Type 1 diabetes
- Decreased risk cerebral palsy
- Improved IQ at 4 years of age

(Genuis SJ. Reproductive Toxicology 2008; 28: 81-85)
Randomized Controlled Trial of Fish Oil Supplementation in Pregnancy on Childhood allergies

Randomized Control Trial - Atopic pregnant women, 368 received 900 mg omega3 capsule and 368 received vegetable oil capsule from 21 weeks of gestation until birth.

No reduction in IgE associated allergic disease in first 3 years of child’s life
Systemic Review & Meta Analysis

Eleven Randomized Control Studies

• Reduce Developmental Delay but no effect on mean Developmental Standard Score at 18 months
• Motor & Language Development
• Visual Development

“Does not support or refute”
A Quantitative Assessment of the Net Effects on Fetal Neurodevelopment from Eating Commercial Fish (As Measured by IQ and also by Early Age Verbal Development in Children)

May 2014

Overall
Average Neurodevelopment benefit
0.7 IQ points (95% CI 0.39-1.37)

Sensitive End Point
Average Verbal IQ points 1.41 (95% CI 0.91-2.00)

Maximum Improvement – 3 IQ points if all pregnant women average 12 ounces/week

http://www.fda.gov/Food/FoodborneIllnessContaminants/Metals/ucm393211.htm
ACOG encourages women to follow the updated FDA recommendations that pregnant women, women who might become pregnant, and breastfeeding mothers should eat at least 8 and up to 12 ounces per week of a variety of fish lower in mercury.
Objectives

• Benefits of Eating Fish/Fish oil
• Risks of Eating Fish/Fish oil
• Store Bought vs. Recreational Caught Fish
• Talking to Patients
• Available Resources
Mercury Poisoning
Episodes & Symptoms

Minamata, Japan, 1943-1961
Ingestion of fish from bay with mercury pollution

Iraq, 1961 & 1971
Ingestion of mercury fungicide contaminated grain

Adults
Ataxia, memory loss, paresthesias, blurred vision and hearing loss

Children
Mental retardation, cerebral palsy, deafness, blindness and dysarthria after exposure in utero

0.1 µg/kg-day (EPA 2005)
Studies of Fish Eating Populations

Seychelles
Faroe Islands
New Zealand

Decreased Performance on neuropsychological tests

0.1 µg/kg-day (EPA 2005)
1.0 PPM (FDA)
Mercury, Fish Oils and Risk of Acute Coronary Events and Cardiovascular Disease, Coronary Heart Disease, and All Cause Mortality in Men in Eastern Finland with Hair Mercury > 2.03µg/g

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Coronary Event</td>
<td>1.6</td>
<td>1.2-2.1</td>
</tr>
<tr>
<td>CVD</td>
<td>1.7</td>
<td>1.2-2.4</td>
</tr>
<tr>
<td>CHD</td>
<td>1.6</td>
<td>0.99-2.5</td>
</tr>
<tr>
<td>Death Any Cause</td>
<td>1.4</td>
<td>1.2-1.7</td>
</tr>
</tbody>
</table>

Fish Intake and Blood Mercury Level in US Women 1999-2004, NHANES

Total Blood Hg (μg/L)

- 75th percentile
- Geometric mean
- 25th percentile

Reported frequency of fish/shellfish consumption:
- Never/rarely (n=1,220)
- 1-2/mo (n=1,470)
- 1-2/wk (n=1,917)
- 3/wk (n=301)
- ≥4/wk (n=212)

Fetal Toxicity

(EHP 2009; 117 47-53)
Summary of Trends in Blood Methyl Mercury (MeHg) and Fish Consumption, Women Aged 16-49 years, NHANES 1999-2010

<table>
<thead>
<tr>
<th>NHANES Survey Years</th>
<th>Blood MeHg Mean µg/L (95% CI)</th>
<th>Fish eaten in 30 days Mean gms (95% CI)</th>
<th>Blood MeHg for women who ate fish 0 times in 30 days Mean µg/L (95% CI)</th>
<th>Blood MeHg for women who ate fish 6+ times in 30 days Mean µg/L (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2000</td>
<td>0.94 (0.74,1.19)</td>
<td>255 (213, 296)</td>
<td>0.61 (0.50,0.72)</td>
<td>3.36 (2.76,3.97)</td>
</tr>
<tr>
<td>2001-2002</td>
<td>0.71 (0.57,0.90)</td>
<td>311 (275, 346)</td>
<td>0.43 (0.33,0.54)</td>
<td>2.34 (1.92,2.75)</td>
</tr>
<tr>
<td>2003-2004</td>
<td>0.56 (0.40,0.78)</td>
<td>270 (235, 305)</td>
<td>0.38 (0.27,0.50)</td>
<td>2.07 (1.68,2.46)</td>
</tr>
<tr>
<td>2005-2006</td>
<td>0.60 (0.44,0.82)</td>
<td>323 (277, 368)</td>
<td>0.37 (0.25,0.48)</td>
<td>1.84 (1.61,2.08)</td>
</tr>
<tr>
<td>2007-2008</td>
<td>0.55 (0.40,0.75)</td>
<td>259 (229, 290)</td>
<td>0.36 (0.25,0.47)</td>
<td>1.95 (1.54,2.37)</td>
</tr>
<tr>
<td>2009-2010</td>
<td>0.69 (0.56,0.86)</td>
<td>309 (269, 348)</td>
<td>0.50 (0.40,0.60)</td>
<td>2.11 (1.87,2.35)</td>
</tr>
</tbody>
</table>

(Adapted from EPA-823-R-13-002, July 2013)
## Store Bought Fish with the Highest Levels of Mercury (about 1 ppm)

<table>
<thead>
<tr>
<th>Fish</th>
<th>Omega-3 fatty acids (grams per 3-oz. serving)</th>
<th>Mean mercury level in parts per million (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tilefish (golden bass or golden snapper)</td>
<td>0.90</td>
<td>1.45</td>
</tr>
<tr>
<td>Shark</td>
<td>0.83</td>
<td>0.99</td>
</tr>
<tr>
<td>Swordfish</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>King mackerel</td>
<td>0.36</td>
<td>0.73</td>
</tr>
</tbody>
</table>
Omega-3 and Mercury Levels of Top 10 Fish and Shellfish in the United States Based on Consumption

<table>
<thead>
<tr>
<th></th>
<th>Omega-3 Fatty Acids (grams per 3-oz. serving)</th>
<th>Mean Mercury Level in Parts per Million (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canned Tuna (light)</td>
<td>0.17–0.24</td>
<td>0.12</td>
</tr>
<tr>
<td>Shrimp</td>
<td>0.29</td>
<td>ND*</td>
</tr>
<tr>
<td>Pollack</td>
<td>0.45</td>
<td>0.06</td>
</tr>
<tr>
<td>Salmon (fresh, frozen)</td>
<td>1.1–1.9</td>
<td>0.01</td>
</tr>
<tr>
<td>Cod</td>
<td>0.15–0.24</td>
<td>0.11</td>
</tr>
<tr>
<td>Catfish</td>
<td>0.22–0.3</td>
<td>0.05</td>
</tr>
<tr>
<td>Clams</td>
<td>0.25</td>
<td>ND*</td>
</tr>
<tr>
<td>Flounder or Sole</td>
<td>0.48</td>
<td>0.05</td>
</tr>
<tr>
<td>Crabs</td>
<td>0.27–0.40</td>
<td>0.06</td>
</tr>
<tr>
<td>Scallops</td>
<td>0.18–0.34</td>
<td>0.05</td>
</tr>
</tbody>
</table>

* ND – mercury concentration below the Level of Detection (LOD=0.01ppm)
Estimated Net Effect of Mercury and Fish Oils on Cardiovascular Risk, Two 6-oz Fish Meals per Week

Percent improvement in relative risk

Shark
Swordfish
Tuna, fresh yellowfin
Canned tuna, white
Lobster
Sea bass
Halibut
Cod
Canned tuna, light
Talapia
Pollack
Flounder
Shrimp
Trout
Herring
Salmon, Atlantic

EHP 2009; 117: 267-275
Chlorinated Hydrocarbons

FDA Limits

DDT - TDE and DDE metabolites 5.0 PPM
PCB’s 2.0 PPM
Dioxin 1.0 ppt
# Adverse Health Effects of Chlorinated Hydrocarbons

## Polychlorinated Biphenyls (PCB’s)

- **Rice Oil Poisoning – Japan 1968 and Taiwan 1979**
  - Adults - Chloracne
  - Children – cognitive abnormalities and swollen gums, deformed nails, hyperpigmentation, acne, Decreased IQ when older

## Chronic Studies

- Michigan and North Carolina Cohorts
  - Multiple neurocognitive defects in children
  - Short term memory deficits, Decreased IQ
  - Decreased muscle tone and activity in infants

## Cancer

## Dioxin

- Anti-estrogen effects
- Cancer
- Diabetes
- Immune suppression
Populations at Increased Risk for Mercury/PCB Toxicity

- Children <15
- Pregnant women
- Women of child-bearing age

Populations at Increased Risk for Accumulation of Toxins from Fish

- Urban subsistence fishers
- Certain immigrant populations (e.g., Hmong)
## Fish vs. Fish Oil

<table>
<thead>
<tr>
<th>Fish</th>
<th>Fish Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>340 gm, (Two 6-oz servings per week)</td>
<td>500-1000 mg EPA &amp; DHA per day</td>
</tr>
</tbody>
</table>

### Positive

<table>
<thead>
<tr>
<th>Benefits in Epi Studies</th>
<th>Benefits in Epi Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Nutrients</td>
<td>Absent</td>
</tr>
<tr>
<td>• Vitamin D</td>
<td></td>
</tr>
<tr>
<td>• Selenium</td>
<td></td>
</tr>
</tbody>
</table>

### Negative

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>Less</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Chlorinated hydrocarbons</td>
<td><a href="http://www.edf.org/page.cfm?tagID=16536">www.edf.org/page.cfm?tagID=16536</a></td>
</tr>
<tr>
<td>• Mercury</td>
<td></td>
</tr>
</tbody>
</table>
# Life Span and Contaminants of Farmed vs. Wild Fish

<table>
<thead>
<tr>
<th>Farmed Fish</th>
<th>Wild Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Life Span</strong></td>
<td></td>
</tr>
<tr>
<td>Atlantic: 1.5-2 years</td>
<td>Pacific: 1-7 years</td>
</tr>
<tr>
<td><strong>Concentrations Omega 3/Contaminants</strong></td>
<td></td>
</tr>
<tr>
<td>Depends on feed source</td>
<td></td>
</tr>
<tr>
<td>• Omega 3</td>
<td></td>
</tr>
<tr>
<td>• Chlorinated hydrocarbons</td>
<td></td>
</tr>
<tr>
<td>• Mercury</td>
<td></td>
</tr>
</tbody>
</table>
Risk-based Consumption Advice Farm VS. Wild Salmon Based on Dioxin/Dioxin Like Contamination

(EHP 2005; 113: 552-556)
Objectives

- Benefits of Eating Fish/Fish oil
- Risks of Eating Fish/Fish oil
- Store Bought vs. Recreational Caught Fish
- Talking to Patients
- Available Resources
### Michigan Fish

<table>
<thead>
<tr>
<th>Freshwater Fish</th>
<th>Saltwater Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bass – Large, Rock, Small Mouth</td>
<td>Perch – White, Yellow</td>
</tr>
<tr>
<td>Bluegill</td>
<td>Northern Pike</td>
</tr>
<tr>
<td>Black Buffalo</td>
<td>Salmon – Chinook, Coho</td>
</tr>
<tr>
<td>Brown Bullhead</td>
<td>Gizzard Shad</td>
</tr>
<tr>
<td>Carp</td>
<td>Sturgeon</td>
</tr>
<tr>
<td>Catfish, Channel</td>
<td>Suckers</td>
</tr>
<tr>
<td>Crappie, Black</td>
<td>Trout – Brown, Lake, Rainbow</td>
</tr>
<tr>
<td>Freshwater Drum</td>
<td>Turbot</td>
</tr>
<tr>
<td>Lake Herring</td>
<td>Walleye</td>
</tr>
<tr>
<td>Muskellunge</td>
<td>Lake Whitefish</td>
</tr>
</tbody>
</table>
Benefits & Risks of Store/Restaurant vs. Recreational Fish

<table>
<thead>
<tr>
<th>Store- or Restaurant-Bought Fish</th>
<th>Recreationally-Caught Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benefits</strong></td>
<td></td>
</tr>
<tr>
<td>Wider Variety</td>
<td>Able to Select Smaller Fish</td>
</tr>
<tr>
<td>Able to Select Oily Fish</td>
<td>Able to Select Fishing Locale</td>
</tr>
<tr>
<td>FDA standard for PCBs/Mercury</td>
<td></td>
</tr>
<tr>
<td><strong>Risks</strong></td>
<td></td>
</tr>
<tr>
<td>Highest Mercury Fish</td>
<td>Possibly Highly Contaminated</td>
</tr>
</tbody>
</table>
Can double serving if not mercury, not limited and follow the 3 C's

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### Benzie County

Map of Benzie County, Michigan

Filets of fish from the lakes and rivers listed here have been tested for chemicals. For all other lakes and rivers in this county, and for any species not listed below, see page 9. Bluegill, perch, and other panfish are often a Best Choice. See page 9 for guidelines if these fish aren’t listed below.

---

### Crystal Lake

<table>
<thead>
<tr>
<th>Type of Fish</th>
<th>Chemicals of Concern</th>
<th>Size of Fish (length in inches)</th>
<th>MI Servings per Month*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Trout</td>
<td>PCBs</td>
<td>Under 18”</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over 18”</td>
<td>1</td>
</tr>
<tr>
<td>Sucker</td>
<td>PCBs</td>
<td>Any</td>
<td>2</td>
</tr>
<tr>
<td>Yellow Perch</td>
<td>Mercury</td>
<td>Any</td>
<td>4</td>
</tr>
</tbody>
</table>

### Lake Ann

<table>
<thead>
<tr>
<th>Type of Fish</th>
<th>Chemicals of Concern</th>
<th>Size of Fish (length in inches)</th>
<th>MI Servings per Month*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largemouth Bass</td>
<td>Mercury</td>
<td>Under 18”</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over 18”</td>
<td>1</td>
</tr>
<tr>
<td>Northern Pike</td>
<td>Mercury</td>
<td>Any</td>
<td>1</td>
</tr>
<tr>
<td>Smallmouth Bass</td>
<td>Mercury</td>
<td>Under 18”</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over 18”</td>
<td>1</td>
</tr>
</tbody>
</table>

*Can double serving if not mercury, not limited and follow the 3 C’s*
Use the Statewide Safe Fish Guidelines ONLY if:

- your lake or river is not listed in the regional *Eat Safe Fish Guide*, OR
- your lake or river is listed in the *Eat Safe Fish Guide*, but the fish species is not listed.

### Statewide Safe Fish Guidelines

<table>
<thead>
<tr>
<th>Type of Fish</th>
<th>Chemical of Concern</th>
<th>Size of Fish (length in inches)</th>
<th>MI Servings per Month*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Crappie</td>
<td>Mercury</td>
<td>Any Size</td>
<td>4</td>
</tr>
<tr>
<td>Bluegill</td>
<td>Mercury</td>
<td>Any Size</td>
<td>8</td>
</tr>
<tr>
<td>Carp</td>
<td>PCBs</td>
<td>Any Size</td>
<td>2</td>
</tr>
<tr>
<td>Catfish</td>
<td>PCBs &amp; Mercury</td>
<td>Any Size</td>
<td>4</td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td>Mercury</td>
<td>Under 18”</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over 18”</td>
<td>1</td>
</tr>
<tr>
<td>Muskellunge</td>
<td>Mercury</td>
<td>Any Size</td>
<td>1</td>
</tr>
<tr>
<td>Northern Pike</td>
<td>Mercury</td>
<td>Under 30”</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over 30”</td>
<td>1</td>
</tr>
<tr>
<td>Rock Bass</td>
<td>Mercury</td>
<td>Any Size</td>
<td>4</td>
</tr>
<tr>
<td>Smallmouth Bass</td>
<td>Mercury</td>
<td>Under 18”</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over 18”</td>
<td>1</td>
</tr>
<tr>
<td>Suckers</td>
<td>Mercury</td>
<td>Any Size</td>
<td>8</td>
</tr>
<tr>
<td>Sunfish</td>
<td>Mercury</td>
<td>Any Size</td>
<td>8</td>
</tr>
<tr>
<td>Walleye</td>
<td>Mercury</td>
<td>Under 20”</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over 20”</td>
<td>1</td>
</tr>
<tr>
<td>White Crappie</td>
<td>Mercury</td>
<td>Any Size</td>
<td>4</td>
</tr>
<tr>
<td>Yellow Perch</td>
<td>Mercury</td>
<td>Any Size</td>
<td>4</td>
</tr>
</tbody>
</table>

These guidelines are based on the typical amount of chemicals found in fish filets tested from around the state. Some fish may be higher or lower. If any of these fish are listed in the guidelines for the lake or river you are fishing in, use those guidelines instead of statewide guidelines. The MI Servings recommendation will be more exact for that lake or river because those filets have been tested.
Choosing Safer Fish

The guidelines in the ESF Guide are set to be safe for everyone. This includes children, pregnant or breastfeeding women, and people who have health problems, like cancer or diabetes.

But the ESF Guide is also for healthy adults who want to avoid getting too many chemicals in their bodies. Chemicals like PCBs and dioxins are linked to cancer, diabetes, and other illnesses. Mercury can cause damage to your brain and nerves. MDCH uses chemical limits in the ESF Guide that will protect everyone who eats fish.

### My Michigan, MI Serving Size
- 8 ounces of fish = size of an adult’s hand (large oval)
- 4 ounces of fish = size of the palm of an adult’s hand (small circle)
- 2 ounces of fish = size of half a palm of an adult’s hand (rectangle)

### How much is MI Serving?

<table>
<thead>
<tr>
<th>Weight of Person</th>
<th>MI Serving Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 pounds</td>
<td>2 ounces</td>
</tr>
<tr>
<td>90 pounds</td>
<td>4 ounces</td>
</tr>
<tr>
<td>180 pounds</td>
<td>8 ounces</td>
</tr>
</tbody>
</table>

For every 20 pounds less than the weight listed in the table, subtract 1 ounce of fish.
For example, a 70 pound child’s MI Serving size is 3 ounces of fish.
90 pounds - 20 pounds = 70 pounds
4 ounces - 1 ounce = a MI Serving size of 3 ounces

For every 20 pounds more than the weight listed in the table, add 1 ounce of fish.
For example, a 110 pound person’s MI Serving size is 5 ounces of fish.
90 pounds + 20 pounds = 110 pounds
4 ounces + 1 ounce = a MI Serving size of 5 ounces

Fish is good for you and your baby! Use your pre-pregnancy weight to find your MI Serving size. It is best to avoid eating fish labeled as “Limited” if you’re pregnant or breastfeeding.

Are you pregnant?
Get to know the **3 Cs**

1. **Choose**

   Going fishing?
   Use the picture below to choose fish to catch that are generally safer for you and your family to eat. Be sure to check the [Michigan Fish Advisory](http://www.michigan.gov/fishadvisory) to find details about the lakes and rivers where you're fishing.

   ![Fish species images](image)
   - Yellow Perch
   - Bluegill
   - Rock Bass
   - Crappie
   - Coho Salmon
   - Chinook Salmon
   - Walleye
   - Northern Pike
   - White (Silver) Bass
   - Largemouth or Smallmouth Bass
   - Rainbow Trout (or Steelhead)
   - Brown Trout
   - Lake Trout
   - Whitefish
   - Catfish

   **These fish are lower in chemicals, and are better to eat.**

2. **Clean**

   Cleaning and cooking your fish the right way can remove up to half of the chemicals!

   - Trim off the dark fatty tissue along the backbone, sides and belly. Most of the chemicals are stored in the fat, except for mercury. Mercury cannot be removed from fish. See page 5 for more information.
   - Take out all organs, such as the liver and stomach. Do not eat the organs.

   ![Cleaning fish diagram](image)
   - Cut away the fat along the back.
   - Remove skin.
   - Cut away the fatty area along the side of the fish.
   - Trim off the belly fat.

3. **Cook**

   - Remove the skin or poke holes in it before cooking. This allows fat to drip off the fish.
   - Cook the fish on a broiler pan or grill so that the fat can drip away through the grates.

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Get a free copy of the [Michigan Fish Advisory](http://www.michigan.gov/fishadvisory) by going to [www.michigan.gov/fishadvisory](http://www.michigan.gov/fishadvisory) or calling 1-800-848-6943.
Objectives

• Benefits of Eating Fish/Fish oil
• Risks of Eating Fish/Fish oil
• Store Bought vs. Recreational Caught Fish
• Talking to Patients
• Available Resources
Awareness of Health Advisories for Consumers of Great Lakes Sport Fish

- Great Lakes fish eaten by 8.4% (95 CI 7.6-9.2) of adults
- 60% (95 CI 53-68) Michigan residents aware of fish advisory

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>2.3</td>
<td>1.5 – 3.4</td>
</tr>
<tr>
<td>White</td>
<td>4.2</td>
<td>1.9 – 9.1</td>
</tr>
<tr>
<td>College Degree</td>
<td>3.1</td>
<td>1.3 – 7.6</td>
</tr>
<tr>
<td>Eating &gt;24 Great Lakes fish meals per year</td>
<td>2.4</td>
<td>1.4 – 4.3</td>
</tr>
</tbody>
</table>

(EHP 1997; 105:1360-1365)
Changes in the amount of fish meals consumed during pregnancy compared to before pregnancy based on receiving information about eating fish during pregnancy; MN, PA, WI

<table>
<thead>
<tr>
<th>Change</th>
<th>Fish consumption during pregnancy</th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Received sport-caught fish info (61.2%)</td>
<td>Received purchased fish info (77.2%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No (%)</td>
<td>Yes (%)</td>
<td>No (%)</td>
<td>Yes (%)</td>
<td></td>
</tr>
<tr>
<td>Did not eat fish or shellfish before or during pregnancy</td>
<td>16.4</td>
<td>7.0</td>
<td>25.3</td>
<td>5.4</td>
<td></td>
</tr>
<tr>
<td>Ate more</td>
<td>7.8</td>
<td>6.2</td>
<td>5.5</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>Ate the same amount</td>
<td>30.6</td>
<td>28.4</td>
<td>31.8</td>
<td>28.5</td>
<td></td>
</tr>
<tr>
<td>Ate less</td>
<td>37.9</td>
<td>53.1</td>
<td>29.7</td>
<td>52.7</td>
<td></td>
</tr>
<tr>
<td>Stopped eating</td>
<td>7.3</td>
<td>5.3</td>
<td>7.7</td>
<td>5.6</td>
<td></td>
</tr>
</tbody>
</table>

(Adapted Environ Res 2014; 135:88-94)
Sample Statements & Focus Group Responses

Less Useful
Statement – “If you follow the fish consumption guidelines, you and your baby will get a lot of the health benefits and have very little risk.”
Response - “It’s long, and I kind of get lost in it.”

Useful
Statement – “Fish are the only source of Omega-3 fats, which may be beneficial during fetal brain and eye development.”
Response – “Why should I eat [fish]?.....And I feel like this says, “Well, eating this is good for you because of this.”

(Adapted Environ Res 2014;135:88-94)
Populations at Increased Risk for Mercury/PCB Toxicity

- Children <15
- Pregnant women
- Women of child-bearing age

Populations at Increased Risk for Accumulation of Toxins from Fish

- Urban subsistence fishers
- Certain immigrant populations (e.g., Hmong)
Clinical Activity

1. Brief Dietary History
   www.aafp.org/afp/990315ap/1521.html
   Starting the Conversation - AJPM 2011; 40(1):67-71

2. Encouraging Fish Consumption

3. Advice for Cooking and Fish Selection
   MDCH Consumer Guide – Eat Safe Fish
   http://www.michigan.gov/mdch/0,1607,7-132-54783_54784_54785_58671-256887--,00.html

4. Advice on fish selection if patient or member of patient’s family catch and eat fish
   http://www.michigan.gov/mdch/0,4612,7-132-54783_54784_54785_58671-296074--,00.html
General Principles of Preparing Fish Safely

1. Trimming and Cooking
   - Cut off all the fat.
   - Remove or poke holes in the fish’s skin before cooking. This will help the fat and chemicals drain off the fish.
   - **Bake, broil or grill** the fish on a rack. Throw away the drippings.
   - Do not eat the guts, head, skin, bones or dark fatty areas.
   - Do not re-use the oil that was used to deep or pan fry fish.

2. Eat fish from different places such as the grocery store, restaurants, rivers and lakes.

3. **Eat smaller, younger fish.** Bigger and older fish have had more time to collect more chemicals in their bodies.

4. Don’t eat fatty fish like carp and catfish from polluted waters. Most chemicals (except for mercury) collect in the fat. Buy catfish from your grocery store instead.

5. Mercury stays in the filet of the fish and cannot be cut or cooked away. Use the guides to choose fish that are low in mercury.
   
   **Do not eat any of the internal organs of any fish from any water body (example: liver).**
# Mercury Reference Values

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Half-Life</th>
<th>Normal</th>
<th>Allowable Workplace Level</th>
<th>Acute Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine</td>
<td>40 days</td>
<td>4µg/L</td>
<td>50µg/L</td>
<td>&gt;300µg/L</td>
</tr>
<tr>
<td>Blood</td>
<td>1-2 days</td>
<td>A 4.6 µg/L</td>
<td>C 1.9 µg/L</td>
<td>&gt;50µg/L</td>
</tr>
</tbody>
</table>
Objectives

• Benefits of Eating Fish/Fish oil
• Risks of Eating Fish/Fish oil
• Store Bought vs. Recreational Caught Fish
• Talking to Patients
• Available Resources
Choosing Fish from Grocery Store/Restaurant

Eating Fish –
Maximizing Benefits &
Minimizing Risks.

Selected References and Resources for Health Professionals:
- Association of Reproductive Health Professionals http://www.ahrp.org/publications-and-resources/clinical-proceedings/RHE
- Fish Facts for Health Professional: Mercury Exposure and Health Effects and Four web based modules www.fish-facts.org

Healthy Fish Choices - Web based 10 CME credits
http://jsons3web.shule.uiuc.edu/healthyfishchoices/index.html

Resources for Patients:
EPA Fish Advisories
http://water.epa.gov/scitech/wagsguidance/fishshellfish/fishadvisories/index.cfm

FDA Mercury in Fish and Shellfish – Consumer Guide
http://www.fda.gov/Food/ResourcesForYou/Consumers/ucm310591.htm

Michigan Dept. of Community Health Eat Safe Fish
http://www.michigan.gov/mdch/0,5807,7-132-54785_54784_54785---00.html

NIHDC Mercury Calculator

General Principles of Preparing Fish Safely – Michigan Department of Community Health

1. Trimming and Cooking
   - Cut off all the fat.
   - Remove or poke holes in the fish’s skin before cooking. This will help the fat and chemicals drain off the fish.
   - Bake, broil or grill the fish on a rack. Throw away the drippings.
   - Do not eat the guts, head, skin, bones or dark fatty areas.
   - Do not re-use the oil that was used to deep or pan fry fish.
2. Eat fish from different places such as the grocery store, restaurants, rivers and lakes.
3. Eat smaller, younger fish. Bigger and older fish have had more time to collect more chemicals in their bodies.
4. Don’t eat fatty fish like carp and saffron from polluted waters. Most chemicals (except for mercury) collect in the fat. Buy saffron from your grocery store instead.
5. Mercury stays in the flesh of the fish and cannot be cut or cooked away. Use the guides to choose fish that are low in mercury. Do not eat any of the internal organs of any fish (example: liver).

Mercury Advisory
for Store-bought or Restaurant Fish

Going to the store or out to eat?

Fish are grouped and assigned points based on the amount of mercury in 6 ounces of fish (one meal). Fish with more mercury get more points.

The lower the score, the better the fish is for you to eat. Eat no more than 8 points of fish meals per month...

- Anchovies
- Catfish (farm-raised)
- Crab
- Crawfish
- Flatfish (flounder, sole)
- Herring*
- Mullet
- Oysters
- Perch* (ocean or freshwater)

- Pollock
- Salmon* (canned, frozen, fresh)
- Sardines
- Scallops
- Shrimp
- Squid
- Tilapia
- Trout* (freshwater)
- Whitefish*

EAT 8 points per month

- Cod
- Freshwater Drum* (aka Sheephead)
- Jack smelt

- Mahi mahi
- Snapper
- Tuna (canned light)

- Bass* (sea, striped, rockfish)
- Bluefish
- Halibut
- Lobster
- Sablefish

- Scorpion fish
- Tuna (Albacore, canned white)
- Tuna (frozen, fresh)
- Weakfish (see trout)

- Grouper
- Marlin
- Mackerel
- Orange Roughy

Do not eat these fish:
- Shark, Swordfish, Tilefish, King Mackerel

This chart is based on FDA fish fillet mercury data.

Advice to eat no more than 8 points is good for everyone, including pregnant women & children.

* If you catch these fish in Michigan, please see the Michigan Fish Advisory at www.michigan.gov/eatsafefish.
Summary

• To maximize the benefits of fish ingestion avoid certain types of fish.

• Children and women of child bearing age, in particular, should avoid/limit ingestion of certain types of fish.

• Availability of consumer guides on fish selection and preparation.
**MSU/EPA Fish Group**

<table>
<thead>
<tr>
<th>CHM/Department of Medicine</th>
<th>COM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gary Ferenchick, M.D.</td>
<td>Kari Hortos, D.O.</td>
</tr>
<tr>
<td>Kenneth D. Rosenman, M.D.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Deborah Sleight, Ph.D.</td>
</tr>
<tr>
<td>David Solomon, Ph.D. (Also Dept Med)</td>
</tr>
</tbody>
</table>

**Funding** - Great Lake Restoration Initiative EPA GL-00E00461