



Methylmercury Exposure of Vulnerable Groups

Health Sector in the Implementation of the Minamata Convention on Mercury
Kingston, Jamaica, 18-19 October 2016

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Presentation

- Benefits and Risks of Fish Consumption
- Fish Advisories
- Risk Communication Strategies

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Benefits of Fish Consumption



- Fish can include 'fish' and 'seafood', can be used interchangeably, and can be defined as fin fish (vertebrates; herbivorous, omnivorous, piscivorous) and shellfish (invertebrates), of marine or freshwater origin, farmed or wild.
- Fish and seafood are healthy components of human nutrition
- Fish is considered as an integral component of a well-balanced diet and provides a healthy source of:
 - Energy,
 - High-quality proteins,
 - Various vitamins (D, A, E and B12),
 - Various essential metals (Se, Mn and Cu),
 - And especially omega-3 fatty acids (also called omega-3 fats and n-3 fats), long-chain n-3 polyunsaturated fatty acids (LCn-3PUFAs), mainly Eicosapentaenoic acid, EPA, 20:5n-3, and Docosahexaenoic acid, DHA, 22:6n-3, play a role in health promotion and disease prevention.

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Benefits of Fish Consumption



- LCn-3PUFAs:
 - Play a vital role in human health from conception through every stage of human development, maturation and aging;
 - Reported health benefits include contributing to normal neurodevelopment in children and lowering the risk of cardiovascular heart diseases.
- Biomedical evidence supports the importance of nutrients in fish in promoting normal nutrition for growth, development, and health maintenance.

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Benefits of Fish Consumption Pregnant and Breastfeeding Women



- Numerous large epidemiological studies have demonstrated that maternal DHA intake from seafood consumption is associated with improved cognitive development; Great Britain, Europe, Republic of the Seychelles, United States and Denmark Strain (2004-2015).
- In those studies it was:
 - Demonstrated that women who eat greater than 12 ounces of fish per week give birth to babies with better cognitive performance, or
 - It correlate fish consumption during pregnancy with cognitive development, or
 - Omega-3 intake from marine sources improved cognitive function in Inuit children whose seafood is known to contain high levels of methyl mercury

Reference Harris MA & Lamm-Kiehl CJ (2016) Pregnant Women and Consumption of Fish: Where are We? In: Fish and Fish Oil in Health and Disease Prevention, pp. 49-60 (S Raitz & D Bibus Eds). Elsevier.

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Benefits of Fish Consumption Fish intake pregnant women and foetal neurodevelopment



- Literature reviewed* on fish intake in pregnant women, with a focus on the association between neurodevelopment outcomes in offspring and maternal fish intake during pregnancy. Included: 279 peer-reviewed journal articles published January 2000 - March 2014, 8 selected for final review.
- Concluded
 - The available evidence indicates that intake of fish during pregnancy is associated with positive foetal neurodevelopmental outcomes, there is a beneficial impact with one or more servings of fish per week compared with no fish intake.
 - Well designed studies are required to strengthen the evidence base for the type and quantity of maternal fish consumption during pregnancy and associated neurodevelopmental outcomes in the offspring, while considering the contribution of mercury from fish-containing diets.

*Sterling P, Charlton K, McMahon A, et al. (2015). Fish intake during pregnancy and foetal neurodevelopment: a systematic review of the evidence. *Nutrients* 7(3), 2007-2014.

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Benefits of Fish Consumption

Concluding Remarks



- There is convincing evidence, from extensive prospective cohort studies and randomized trials in humans, together with supportive retrospective, ecological, metabolic and experimental animal studies, of beneficial health outcomes from fish consumption for:
 - Improved neurodevelopment in infants and young children when fish is consumed by the mother before and during pregnancy.
 - Reduction in risk of coronary heart disease.
- There is emerging possible/probable evidence that fish consumption may reduce the risk of multiple other adverse health outcomes, including ischemic stroke, non-fatal coronary heart disease events, congestive heart failure, atrial fibrillation, cognitive decline, depression, anxiety and inflammatory diseases
- The benefits of fish consumption, demonstrated in numerous studies, reflects the sum of benefits and risks of fish consumption.
- Eating fish is a part of the cultural traditions of many people/populations, and in some populations fish is a major source of food and essential nutrients in their daily diet.
- In some communities fish can be the primary food source that contributes substantially to food security.

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Risks of Fish Consumption



- Fish and seafood are not independent of the environment in which they live. Both essential minerals and harmful metals, such as As, Cd, and Pb, and chemical pollutants, such as methylmercury and dioxins, present in the environment are absorbed by the fish.
- In this food group methylmercury (also dioxins) has emerged as an issue of concern, particularly for frequent fish consumers and sensitive groups of populations.
- There is convincing evidence of adverse neurological/neurodevelopmental outcomes in infants and young children associated with methylmercury exposure during fetal development due to maternal fish consumption during pregnancy.

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Risks of Fish Consumption

Prenatal exposure



- Depending on the dose and timing of exposure to methylmercury during gestation, the effects may be severe and immediately obvious, or subtle and delayed.
- Effects of prenatal methylmercury exposure, the neurological symptoms include:
 - Mental retardation
 - Ataxia & cerebral palsy
 - Seizures
 - Vision & hearing loss
 - Delayed developmental milestones
 - Language disorders
 - Deficits in fine motor function
 - Visual spatial disabilities
 - Memory problems



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Fish Advisories



Metal content:

- Metal contaminants* are naturally present in the environment but can be increased through industrial activity and pollution.
- The concentrations and uptake of these metals in (marine) organisms are subject to environmental and species-specific biological factors as well as the chemical and physical state of the metals.
- Different fish species accumulate metals at different rates and to different levels (herbivorous fish, omnivorous, carnivorous fish).
- Different metals accumulate differently within the same fish species
- One specific metal is accumulated at different levels in different tissues within one fish.

*Boach A, O'Neill B, O'Sigge G, et al. (2015). Heavy metals in marine fish meat and consumers health: a review. *Journal of the Science of Food and Agriculture* 95, 32-46.

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- When determining the consumer safety of fish with regards to metal content, it is important to consider these factors.
- Besides fish metal content we need to consider the fish consumption patterns:
 - Seasonal variation
 - Fish size and species variation
 - Personal preferences
 - Cultural influences
 - Etc

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Fish Advisories



- Fish advisories have been developed to balance the presence of chemical contaminants in fish vs. the benefits of fish consumption.
- Driven forces the public health responsibilities and/or growing public concern.
- Based on national/local data and professional knowledge the advisories on the health risks vs. health benefits of fish consumption can be more or less detailed and are country/location specific

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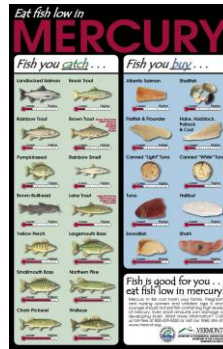
Fish Advisories

- Based on target(group) there will be a different:
 - Format
 - Design
 - Detail

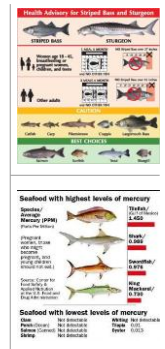


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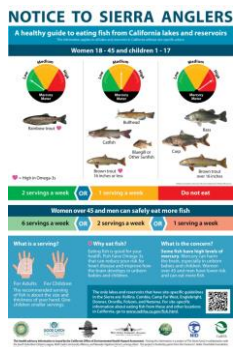
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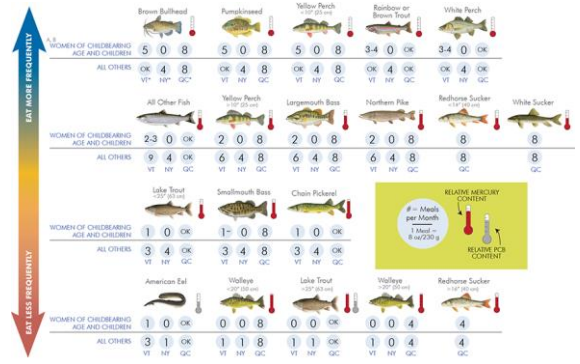


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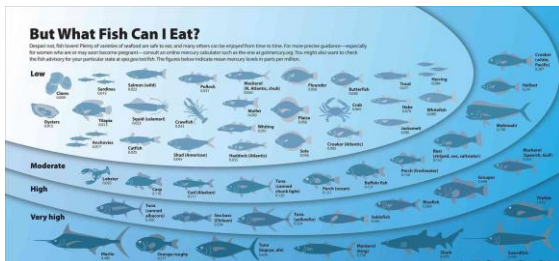
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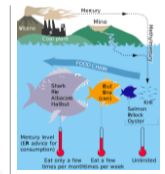
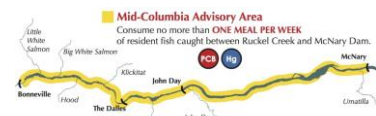
A - The VT advisory applies to women of childbearing age, particularly pregnant women, women planning to get pregnant and breastfeeding women, as well as children age six or younger.
 B - The NY advisory applies to women of childbearing age, infants and children under the age of 15.
 C - All VT advisories are state-wide. Lake trout and walleye advisories in NY are specific to Lake Champlain; the American and advisory is specific to Connecticut Bay. The QC advisories are all specific to Mississippi Bay.
 D - Walleye Lake trout > 10" (40 cm) and consumption limited to 10 meals per month for women and children in VT.
 E - If there is no number, there is no advisory for that condition. If there is an "OK", the fish falls into the general advisory for that jurisdiction.
 SOURCES: NY Department of Health, 2014; VT Department of Health, 2013; QC Department of Health, April 2006.

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Fish Advisories

The proper design



- The ratio behind it:
 - Identify the population at risk;
 - Minimize the risk in target population;
 - Based on (research) data;
 - Consider a holistic approach;
 - Information exchange and education;
 - Proper risk communication strategies.

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The proper design



Identification population at risk:

- In recent years, the evolving science and debate concerning the benefits and risks of consuming fish have resulted in confusion as to how much, or even if, fish should be consumed, and by whom.
- International and national food safety agencies have recognized the need to provide useful, clear and relevant information to populations that are concerned about making the healthiest choices when considering whether or not to eat fish.
- The population groups that can be distinguished are: women of reproductive age, pregnant or nursing women, breastfed infants and young children, and high fish consumers.

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Minimize the risk in target population:

- Fish consumption may pose toxicological risks, including neurodevelopmental delay, in fetuses and young children. Notably, these same groups are also sensitive populations for neurodevelopmental risks from not consuming fish.
- The health benefits and risks are likely to vary according to the fish species, fish size, and harvesting and cultivation practices, as well as the amount consumed, which depends on seasonal variations, personal preferences, cultural influences, etc.

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Based on (research) data:

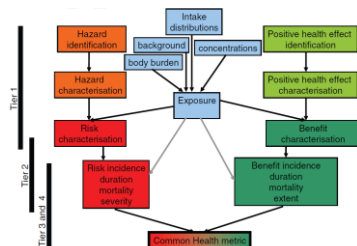
- Several international risk-benefit activities can serve as examples for the kind of framework needed for the quantitative consideration of the risks and benefits of fish consumption.
- Benefit-Risk Analysis of Foods, BRAFO, tiered approach for benefit-risk assessment of foods:
 - Tier 1, each risk or benefit is assessed independently.
 - Tier 2, risks and benefits are compared in a qualitative way.
 - Tier 3, risks and benefits are integrated quantitatively in a common metric by a deterministic approach.
 - Tier 4, risks and benefits are integrated quantitatively in a common metric by a probabilistic approach.

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Risk-benefit assessment methodology European Union:

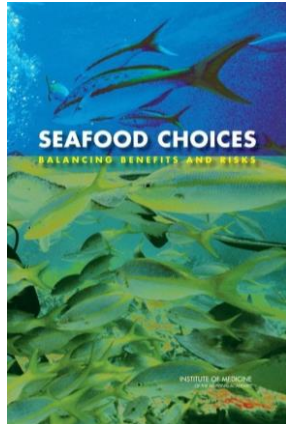
- Benefit-Risk Assessment for Food: An Iterative Value-of-Information Approach (BENERIS) project, a framework for handling complicated benefit risk situations and apply it for the analysis of benefits and risks of certain foods. The first food commodity that was used was fish. Clustered with the Quality of Life – Integrated Benefit and Risk Analysis (QALIBRA) project developed a web-based tool for assessing food safety and health benefits (2006-2009).
- Scientific Committee of the European Food Safety Authority (EFSA) developed a guidance document for performing risk-benefit assessments of food (2010). It does not address cost-effectiveness or other ethical, social or economic considerations. It is a guidance document similar to the BRAFO methodology. Both methods identify the need for proper problem formulation before the actual assessment is performed, there is overlap between the tiers/steps.
- Risk-benefit characterization through integration of risks and benefits by expressing them in a common metric, such as the disability adjusted life year (DALY) or quality-adjusted life years (QALYs)

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- In 2006, as a result of conflicting consumer messages and lack of consensus in the scientific community, the National Oceanic and Atmospheric Administration, USA, commissioned a report by the Institute of Medicine of the National Academies, with support from the USFDA, to evaluate the risks and benefits associated with seafood consumption.
- It also made recommendations for consumers in the USA, to create a more comprehensive understanding that would enable consumers to make educated decisions when selecting seafood (Nesheim and Yaktine, 2007).



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- The Institute of Medicine (IOM) developed a step-by-step decision framework, which evaluated the risks and benefits of seafood consumption based on scientific evidence to examine four population groups:
 1. Females who are or may become pregnant or who are breastfeeding,
 2. Children up to 12 years of age,
 3. Healthy adolescent and adult males and females (who as defined by the IOM report will not become pregnant), and
 4. Adult males and females who are at risk of coronary heart disease.
- A decision pathway was then created with this information, highlighting the factors for categorizing consumers in specific target groups that face different benefits and risks and that should receive appropriately tailored advice.

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- Report Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption, 2011. FAO Fishery and Aquaculture Report. No. 978.
- The output of the Expert Consultation is a framework for assessing the net health benefits or risks of fish consumption that will provide guidance to national food safety authorities and the Codex Alimentarius Commission in their work on managing risks, taking into account the existing data on the benefits of eating fish.
- The risks and benefits of fish consumption: specifically, a comparison of the health benefits of fish consumption with the health risks associated with the contaminants methylmercury and dioxins

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- "It should also be emphasized that for much of the evidence related to the assessment of these health benefits, the measured exposure of interest was fish consumption, which implicitly quantifies the net overall effect, including both the harm and benefit, of fish consumption."
- "Additionally, health benefits of fish consumption or dietary intake of LCn-3PUFAs are often assessed using imprecise dietary estimates, whereas health risks of contaminants are often assessed using objective biomarkers. Substantially greater misclassification, with resulting underestimation of effects, will occur with the former methods."

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- When balancing the risks of methylmercury with benefits of LCn-3PUFAs (EPA/DHA) the Expert Consultation decided after reviewing the literature to compare the effects of prenatal exposure to LCn-3PUFAs and methylmercury on child IQ .
- The rationale for this choice is based on the common health end-points and relatively robust evidence to establish dose-response relationships from multiple cohort studies that provide the basis for a quantitative risk-benefit analysis.

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- WHO human health risk assessment toolkit: chemical hazards. (IPCS harmonization project document; no.8), WHO/IPCS, 2010
- Other international/regional risk-benefit activities as examples for the kind of framework needed for the quantitative consideration of the risks and benefits of fish consumption?

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- Gaps in data:
 - Local food consumption data studies, qualitative and quantitative.
 - Local existing databases on specific nutrients and contaminants, particularly methylmercury, in fish consumed.

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Consider holistic approach:

- Consider the social and environmental context in which there is much consumption of fish because there are no alternative protein sources, costly or lack of it.
- The welfare value of a fish advisory. The conventional economic wisdom is that improving consumer information will enhance welfare. When the fish advisory is not properly designed, lowering the methylmercury intake can result in lowering the LCn-3PUFAs intake at the expense of offsetting health impacts.
- Consider the potential effects of methylmercury intake and other subclinical aspects of intellectual disability that, in the context of other competing ill-health demands, might not be perceived or considered relevant for health and well being.
- Cultural tradition indigenous populations, use culturally appropriate and context relevant health indicators.

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Information exchange and education:

- To minimize risks in target populations, the Joint FAO/WHO E.C. recommended steps Member States can take to better assess, manage risks and benefits of fish consumption, and more effectively communicate with their citizens:
 - Acknowledge fish as an important food source of energy, protein and a range of essential nutrients and consumption as part of cultural traditions of many peoples.
 - Emphasize the benefits of fish consumption on reducing mortality from coronary heart disease (and the risks of mortality from coronary heart disease associated with not eating fish) for the general adult population.
 - Emphasize the net neurodevelopmental benefits to offspring of women of childbearing age who consume fish, particularly pregnant women and nursing mothers, and the neurodevelopmental risks to offspring of women of childbearing age who do not consume fish.
 - Develop, maintain and improve existing databases on specific nutrients and contaminants, particularly methylmercury, in fish consumed in their region.
 - Develop and evaluate risk management and communication strategies that both minimize risks and maximize benefits from fish consumption.

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Proper Risk Communication Strategies



- Different target groups:
 - Tailored advisories may be issued for the general public or for specific groups of people at risk, such as pregnant women, nursing mothers, children, high consumers of fish.
- Understanding how best to communicate the benefits and risks of fish consumption to consumers especially to sensitive populations, both real and perceived, is a continuing challenge.
- Challenges, difficulties for the public to interpret :
 - The quantification of health risks and benefits for a specific dietary pattern.
 - Toxicological risks and nutritional benefits may not be directly comparable and may change in importance during different life stages.
 - Are cross-disciplinary, reaching across different branches of science.

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Proper Risk Communication Strategies



- Trust:
 - Is there public trust in the regulator?
 - It can be reallocated, public trust individuals or special interest groups who are perceived not to have vested interest in the subject add hand. These individuals or special interests groups can become rather powerful in setting the regulator agenda.
- Regulator:
 - Inaction against real risks can undermine public trust.
 - Especially if not well represented in areas of the country where it's an issue of concern because of limited capacity, knowledge, etc.
 - Work together with initiatives and focus on guidance and how?

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Proper Risk Communication Strategies



- Develop a risk communication strategy plan
- Pilot phase
- Evaluate:
 - Does the advisory has the intended effect of minimizing risk in the targeted population?
 - Or does it instead increases the risk by causing both sensitive populations and the general population to reduce or avoid fish consumption altogether?

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"You told me to eat more fish, but my weight stays the same no matter how many anchovies I put on my pizza!"

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"Did your doctor say 'eat more fish' or 'eat fish more often?'"

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<http://www.who.int/ipcs/network/en/>

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Thank you

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