



**Food and Agriculture
Organization of the
United Nations**



**World Health
Organization**

Joint FAO/WHO Expert Consultation on Risks and Benefits of Fish Consumption

FAO, HQ, Rome, Italy: 9 - 13 October 2023

SUMMARY AND CONCLUSIONS

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The main purpose of the ad hoc Joint FAO/WHO Expert Consultation on Risks and Benefits of Fish Consumption was to examine the results of recent systematic literature reviews on the risks and benefits of fish consumption, draw conclusions regarding the risks and benefits associated with fish consumption, and recommend a series of steps to better assess and manage the risks and benefits of fish consumption.

This document summarizes the key conclusions of the Joint FAO/WHO Expert Consultation on Risks and Benefits of Fish Consumption. The full report will be published and will describe the scientific evidence available to the Expert Committee and its deliberations during the meeting.

The meeting participants are listed in Annex 1 of this summary report.

More information on this work is available at:

<http://www.fao.org/food-safety/en/>
<https://www.fao.org/fishery-aquaculture/en>
and

<https://www.who.int/foodsafety/en/>

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Scope and objectives

The thirty-eighth Session of the Codex Committee on Food Additives and Contaminants requested the Codex Alimentarius Commission, at its twenty-ninth Session in 2006, to seek scientific advice from the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) on the risks and benefits of fish consumption (FAO and WHO, 2011). Specifically, the committee requested a comparison of the health benefits of fish consumption with the health risks associated with the contaminants, methylmercury and dioxins (defined here to include polychlorinated dibenzo-p-dioxins [PCDDs] and polychlorinated dibenzofurans [PCDFs] as well as dioxin-like polychlorinated biphenyls [dl-PCBs]), that may be present in fish. The Codex Alimentarius Commission request was driven by growing public concern in recent years regarding the presence of chemical contaminants in fish. Over the same period, the multiple nutritional benefits of including fish in the diet have become increasingly clear.

FAO and WHO held an Expert Consultation on the Risks and Benefits of Fish Consumption from 25 to 29 January 2010 at FAO headquarters in Rome, Italy. Data on levels of nutrients (the long-chain n-3 polyunsaturated fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) and specific chemical contaminants (methylmercury and dioxins) in a range of fish species were reviewed, as well as scientific literature covering the risks and benefits of fish consumption. The review was used to consider risk-benefit assessments for specific endpoints, including for sensitive groups of the population. The document resulting from this review was used in a subsequent expert consultation, resulting in a Report of the Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption, published in 2011 (FAO and WHO, 2011).

Since then, new evidence has become available, and the thirty-fifth Session of the Codex Committee on Fish and Fisheries products in 2021 agreed on the added value of updating the previous report regarding the new evidence on risks and benefits of fish consumption (FAO and WHO, 2021). In response, in October 2023, FAO and WHO held a second Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption to conduct an analysis of new scientific evidence that will be used to update the FAO-WHO Report with relevant conclusions and recommendations.

Three main objectives guided the expert consultation to set a framework for assessing the health benefits and risks of fish consumption and to provide guidance to the Codex Alimentarius Commission in their work on managing risks, taking into account the existing data on the risks and benefits of consuming fish:

- i) examine the results of recent systematic literature reviews on risks and benefits of fish consumption;
- ii) draw conclusions regarding the health benefits and risks associated with fish consumption; and
- iii) recommend a series of steps that Member States could take to better assess and manage the risks and benefits of fish consumption.

The term “fish”, which is defined as finfish (vertebrates) and shellfish (invertebrates), whether of marine or freshwater origin, farmed or wild, for the purpose of this meeting. Marine mammals and algae, as well as sustainability issues and environmental impacts, although important, are considered to be outside the scope of the report.

Approach

FAO and WHO commissioned a systematic literature review from the Norwegian Institute of Marine Research (IMR) that was used to generate a FAO/WHO Background Document on the Risks and Benefits of Fish Consumption (hereafter referred to as Background Document) to inform the Expert Consultation.

The IMR review covered existing evidence scans (the report on “Benefit and risk assessment of fish in the Norwegian diet” published by The Norwegian Scientific Committee for Food and Environment (Andersen et al., 2022); the report from the World Cancer Research Fund (World Cancer Research Fund International, 2018); as well as reports from the European Food Safety Authority (EFSA) containing expert opinion on methylmercury (MeHg) (EFSA Panel on Contaminants in the Food Chain (CONTAM), 2012), and Dioxins (EFSA Panel on Contaminants in the Food Chain (CONTAM) et al., 2018); etc.) as well as additional publications identified from a systematic literature search to identify publications not considered in these prior evidence scans. To provide new scientific evidence, five extensive literature reviews were conducted to develop this background report focusing on the following topics:

1. Evidence of health benefits from fish consumption. To evaluate the evidence of health benefits from fish consumption, the literature consisted of the report VKM published in 2022 in addition to literature (systematic reviews and original primary studies) included from a systematic literature search.

2. Toxic effects of dioxins and dl-PCBs. To evaluate the evidence of toxic effects of dioxins and dl-PCBs (published since the 2010 Expert Consultation), the literature consisted of the EFSA Dioxin Report from 2018 and literature (original primary studies) included from a systematic literature search.

3. Toxic effects of MeHg. To evaluate the evidence of toxic effects of MeHg (published since the 2010 Expert Consultation), the literature consisted of the EFSA MeHg Report from 2015 and the VKM Report 2022, and literature (systematic reviews and original primary studies) included from a systematic literature search.

4. The role of selenium (Se) regarding the health effects of MeHg. To evaluate the evidence of the role of Se regarding the health effects of MeHg, the literature consisted of original primary studies included from a systematic literature search.

5. Occurrence data for MeHg, and dioxins and dl-PCBs, in fisheries and aquaculture products. To evaluate the data for MeHg, and dioxins and dl-PCBs in fisheries and aquaculture products published since the 2010 Expert Consultation, data were obtained from public databases (WHO Global Environment Monitoring System (GEMS) database and EFSA’s Chemical Monitoring database) and extracted from the literature included from a systematic literature search.

For the ‘Health Benefits of Fish Consumption’ and for the ‘The Role of Se with regard to the health effects of MeHg’, a final weight of evidence using the grading classifications from the World Cancer Research Report 2018 was performed grading the evidence for the different health outcomes into the categories of “convincing” “(strong evidence)”, “probable” “(strong evidence)”, “limited, suggestive”, “limited, no conclusion”, or “substantial effect of risk unlikely” (strong evidence).

Summary of the meeting

The Experts participating in the meeting were selected from a global public call for experts. A total of 21 experts were selected covering different areas of expertise, including nutrition, toxicology, epidemiology, dietary exposure of MeHg and risk-benefit assessment (list in Annex 1). The experts were supported by the resource persons who authored the systematic literature reviews.

Based on the strength of the evidence provided in the background document and considering the 2010 Expert Consultation report, the panel examined the benefits of total, fatty, and lean fish consumption for a number of human health outcomes including allergy and immunology, birth and growth outcomes, bone health, cancer, cardiovascular disease, type 2 diabetes, mortality, neurodevelopment and neurological

disorders, and overweight and obesity. Potential adverse effects of dioxins were investigated with respect to chloracne and other dermal effects, male and female reproductive effects, birth outcomes, thyroid disease and thyroid hormones, type 2 diabetes and obesity, cardiovascular effects, hepatic disorders and digestive effects, effects on immune system, effects on the nervous system, effects on teeth and bones and cancer. Exposure to methylmercury from fish consumption was considered for neurological outcomes, cardiovascular outcomes, growth, and other health outcomes. Furthermore, the role of selenium with respect to methylmercury effects was investigated for cardiovascular outcomes, oxidative stress, immune system, reproduction, thyroid hormones, birth outcomes, neurodevelopment and cognition, vision function, and motor function.

Conclusions

The 2023 Joint FAO/WHO Expert Consultation agreed on the following overall conclusions regarding human health benefits from fish consumption:

- Consuming fish provides energy, protein and a range of other nutrients important for health.
- Consuming fish is part of the cultural traditions of many peoples. In some populations, fish is a major source of food, animal protein and a range of other nutrients that are important for health.
- Strong evidence exists for the benefits of total fish consumption during all life stages: pregnancy, childhood, and adulthood. For example, associations are found for maternal consumption during pregnancy with improved birth outcomes and for adult consumption with reduced risks for cardiovascular and neurological diseases. This evidence for health benefits of total fish consumption reflects the overall effects of nutrients and contaminants in fish on the studied outcomes, including nutrients and contaminants not specifically considered in the evidence review.
- Benefits derived from general population studies and individual effects will vary depending on overall diet (e.g. selenium intake, exposure to other contaminants) and characteristics of consumers (e.g. n-3 PUFA status and individual susceptibility) and fish consumed (e.g. fish species and food preparation methods).
- Risk-benefit assessments at regional, national, or subnational levels are needed to refine fish consumption recommendations considering local consumption habits, fish contamination levels, and nutrient content, nutritional status of the population of interest, cultural habits, and demographics.

In addition, the Joint FAO/WHO Expert Consultation agreed on the following conclusions relating to the toxic effects of dioxins and dl-PCBs, MeHg, and the role of selenium regarding the health effects of MeHg.

- Studies are lacking regarding effects of dioxins and dl-PCBs exposure from fish consumption on human health in general populations. The current evidence base is mainly from populations highly exposed to dioxins and dl-PCBs because of occupational exposure or local contamination.
- Dietary exposure to dioxins and dl-PCBs comes from multiple different foods of animal origin, including fish. The contribution of fish consumption to these exposures will vary based on region of residence and the amount, source and types of fish consumed.
- There is consistent evidence for an association between dioxin exposure and reduced semen quality. Exposure to total dioxins and dl-PCBs has been associated with altered sex ratio and weaker tooth enamel.

- Maternal fish consumption during pregnancy is associated with improved offspring neurological development, despite evidence from some populations showing that MeHg exposure from fish consumption in early life (prenatal and early childhood) has been associated with less neurodevelopmental benefit.
- There is limited evidence of adverse health effects from MeHg exposure in relation to cardiovascular, neurological and other health outcomes in adulthood.
- There is heterogeneous evidence regarding associations of childhood MeHg exposure with neurological outcomes in childhood, possibly reflecting differences in study populations, including Se status.
- Based on physiological mechanisms and evidence from animal studies MeHg health effects will vary according to Se status and intake; however, evidence from human studies was limited in this assessment.

Identified challenges and data gaps

- Evidence is lacking regarding associations of dioxins and dl-PCBs from fish consumption with health endpoints (e.g. semen quality), therefore the Expert Consultation could not draw firm conclusions.
- This Expert Consultation did not consider other contaminants in fish potentially related to human health such as non-dioxin like PCBs, per- and polyfluorinated alkyl substances (PFAS) and polybrominated diphenyl ethers (PBDEs).
- Mechanisms of biological effects are a key piece of evidence that allows for refining the strength of evidence estimation. The Expert Consultation was limited in that a comprehensive evaluation of mechanistic studies (e.g. for marine omega-3 fatty acids in fish, mechanistic studies on Se) was not considered in the Background Document.

Research needs

- Future research on health effects associated with fish-derived nutrients or contaminants should include an overall estimate for the association of fish intake with the health outcome of interest.
- Research is needed to better elucidate the contribution of dioxins and dl-PCBs and other contaminants from fish consumption to human health outcomes in general populations beyond highly contaminated regions.
- Future research could consider the effects of food processing and preparation on nutrient and contaminant concentrations and bioavailability (or bio-accessibility) associated with fish consumption.
- As much as possible, future research should differentiate the type of fish consumed including species, source (i.e. freshwater versus marine, capture vs. aquaculture), fatty versus lean, and geographic location of catch.
- Dose-response studies/meta-regression analyses, especially for outcomes with probable benefits, will help refine public health guidance about optimal fish consumption amounts.
- More research is needed on factors that explain observed heterogeneity in health effects of fish consumption across the life course, for example overall diet quality, genetic polymorphisms, and nutrient profiles of fish consumed including the Se:Hg molar ratio, particularly in populations at risk of Se deficiency.
- Further information is needed on contaminant and nutrient concentrations in fish. The Expert Consultation recommends future work to: (i) collect more data and reassess already-available data on fish species in regions where data are sparse; especially in freshwater fish; (ii) develop a

statistical model to describe and predict the variability of the level of contamination in different species of fish which can be used to assess the level of exposure to contaminants in fish by FAO area or country level in a target population for risks and benefits assessment ; (iii) collect data using harmonized guidelines and submit them to the Global Environment Monitoring System (GEMS) / Food Contamination Monitoring and Assessment Programme .

- Future studies should consider the aggregate impacts of fisheries depletion for Planetary Health effects on population health outcomes, etc. (in connection with SDG14 and SDG2, SDG3) and the impact of climate change on the net risk or benefit of fish consumption (in connection with SDG13 and SDG2, SDG3).

Recommendations

To maximize benefits of fish consumption for the general population across all life stages, the Expert Consultation recommends that Member States:

- Acknowledge fish as an important dietary source of energy, protein and a range of other nutrients important for health, and that fish consumption is an important part of the cultural traditions of many populations.
- Emphasize the benefits of fish consumption for multiple health outcomes throughout the life course including during pregnancy, childhood and adulthood.
- Collect standardized data on fish contaminants and nutrients.
- Develop, maintain and improve existing databases on levels and trends over time of specific contaminants, in particular MeHg, dioxins and dl-PCBs, as well as nutrient content, such as selenium and long chain omega-3 fatty acids (LCn3PUFAs), for fish consumed by region.
- Collect standardized data on dietary intake of fish including amount, type and source, representative at regional, national or subnational levels for quantitative risk-benefit assessment of fish.
- Develop and evaluate risk analysis strategies (risk assessment, risk management and risk communication) that maximize benefits and minimize risks from consuming fish.

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Annex 1: List of participants

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