

**sacn**

Scientific Advisory Committee on Nutrition

# **Advice on fish consumption: benefits & risks**

**2004**

London: TSO

Committee on \_\_\_\_\_  
**TOXICITY**

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## Preface

The aim of this report is to bring together the nutritional considerations from the Scientific Advisory Committee on Nutrition (SACN) on fish consumption and the toxicological considerations from the Committee on Toxicity (COT) on the contaminants in fish. An Inter-Committee Subgroup was established to conduct the risk assessment. The Subgroup weighed the nutritional benefits against possible risks and developed coherent dietary advice for the public on the consumption of fish, with particular reference to oily fish.

This is the first time that SACN and COT have worked so closely together on an issue and I should like to thank the Inter-Committee Subgroup members for their participation in this successful collaboration.

A large body of evidence suggests that fish consumption, particularly of oily fish, reduces cardiovascular disease risk; furthermore, there is also evidence that increased fish consumption might have beneficial effects on fetal development. Balanced against this, however, are the possible detrimental effects associated with the contaminants found in fish.

Interested parties have commented that mixed messages are being given to consumers and so this review aims to bring these views together in order to allow the Food Standards Agency to provide clear and helpful advice to consumers.

An important consideration in this assessment is dose: both for the beneficial effects as well as the risks. Overall, the UK population should be encouraged to eat more fish, especially oily fish. An increase in population oily fish consumption to one portion a week, from the current levels of about a third of a portion a week, would confer significant public health benefits without appreciable risk from the contaminants in fish.

Now that the Inter-Committee Subgroup has completed its risk assessment, it is for the Food Standards Agency to explain these complex issues to the public in a manner that is easily understood. I should like to emphasize the

need to encourage fish consumption, particularly oily fish, and the need to communicate to consumers the important messages in plain, clear English.

I should like to thank the Inter-Committee Subgroup members for their commitment and enthusiasm. I should also like to thank the Secretariat for their contribution to the risk assessment and the production of this report.

Professor Alan Jackson  
Chair of the Inter-Committee Subgroup

# Contents

	<b>Page</b>
<b>Preface</b>	<b>i</b>
<b>Membership of Scientific Advisory Committee on Nutrition: SACN/COT Fish Inter-Committee Subgroup</b>	<b>v</b>
<b>Membership of the Scientific Advisory Committee on Nutrition (SACN)</b>	<b>vii</b>
<b>Membership of Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT)</b>	<b>xi</b>
<b>1 Advice on fish consumption – overview</b>	<b>1</b>
The nutritional considerations	1
The toxicological considerations	4
Conclusions	7
<b>2 The nutritional considerations</b>	<b>10</b>
The effects of LC PUFA on early human growth and cognitive function	10
Fish consumption and cardiovascular disease	12
Conclusions	30
<b>3 The toxicological considerations</b>	<b>52</b>
General toxicological principles	52
Organic contaminants	53
Inorganic contaminants	72
<b>Annexes</b>	
<b>1 Fish consumption in the UK</b>	<b>103</b>
<b>2 Docosahexaenoic acid requirements in pregnancy and lactation</b>	<b>107</b>
<b>3 COT statement on a survey of mercury in fish and shellfish</b>	<b>120</b>
<b>4 COT statement on brominated flame retardants in fish from the Skerne Tees rivers system</b>	<b>144</b>

<b>5</b>	<b>COT statement on the tolerable daily intake for dioxins and dioxin-like polychlorinated biphenyls</b>	<b>166</b>
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## Advice on fish consumption

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# 1 Advice on fish consumption – overview

- 1.1 The Food Standards Agency (FSA) sought advice from the Scientific Advisory Committee on Nutrition (SACN) and the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) on the benefits and risks of fish consumption, with particular reference to oily fish. A joint SACN/COT Subgroup was convened to consider the matter. The aims of the Inter-Committee Subgroup were to: bring together the nutritional considerations from SACN on fish consumption and the toxicological considerations of the contaminants in fish from COT; and weigh the nutritional benefits against possible risks and develop coherent dietary advice for the public on consumption of fish, with particular reference to oily fish.

## **The nutritional considerations**

- 1.2 For detail see the nutritional considerations section. SACN reviewed the evidence on the health benefits of fish and fish oil consumption, with specific reference to cardiovascular disease risk and pregnancy outcome. The UK recommendations on fish consumption and long chain n-3 polyunsaturated fatty acid (LC n-3 PUFA) intake (Department of Health, 1994) were considered in light of the evidence that had arisen since they were made. The reported benefits of fish consumption on the development of some cancers and other aspects of brain function (e.g. cognitive decline) were not considered due to the paucity of data.
- 1.3 Evidence suggests that fish consumption, particularly that of oily fish, decreases the risk of cardiovascular disease (CVD); this is thought to be due to their LC n-3 PUFA content. The recommendation made by the Committee on Medical Aspects of Food Policy (COMA) to ‘eat at least two portions of fish, of which one should be oily, weekly’ (Department of Health, 1994) was based on a review of scientific evidence that related fish consumption (especially oily fish and fish oils) inversely to coronary heart disease (CHD). As most people in the UK consume considerably less than

one portion of oily fish per week, COMA concluded that CHD reductions would be gained by increasing levels of consumption.

- 1.4 In pregnancy and lactation there is a demand on the mother to supply the fetus and infant with LC n-3 PUFA, which are required for the development of the central nervous system. There is some evidence that increased maternal LC n-3 PUFA intake produces beneficial effects, especially in lower birth weight populations, and this may be more relevant in populations that tend to have a lower background intake of LC n-3 PUFA, i.e. where fish intake is low. No adverse effects of maternal LC n-3 PUFA supplementation have been observed, even at relatively high doses.
- 1.5 The dose-response relationship is derived from the cardiovascular evidence, as the evidence for maternal intake and pregnancy outcome is insufficient for this.
- 1.6 Randomized controlled trials (RCT) with subjects who had previously experienced a myocardial infarction (MI) have only used one dose of 0.9g/d LC-n-3 PUFA, which is equivalent to two-three portions of oily fish per week. These trials provide evidence that increased fish consumption, or fish oil supplementation, decreases mortality among patients who have suffered a MI. The most probable mechanism for the effect of 0.9g/d LC n-3 PUFA on secondary CHD prevention is the stabilization of arrhythmias. One randomized trial in angina patients found an adverse effect of fish advice on cardiac mortality.
- 1.7 The prospective epidemiological evidence is suggestive of a plateau effect in high-risk populations, at intakes of about 0.9g/d; however, where fatty acid composition analyses of blood or blood compartments have been determined, a positive relationship, with no plateau, is observed.
- 1.8 A number of studies have examined the mechanism by which fish oil improves cardiovascular health. Such studies have shown that a higher dose, of at least 1.5 g/d LC n-3 PUFA, is required for demonstrable beneficial effects on cardiovascular risk factors such as a reduction of

plasma triacylglycerol levels, blood pressure, platelet aggregation and the inflammatory response.

- 1.9 The evidence provided by RCTs is suggestive of beneficial effects occurring within a short time scale, from a few months to 2 years. Prospective studies, however, suggest a longer time-course before a beneficial effect is observed which might be due to a combination of statistical and biological considerations. The dose-response relationship between fish consumption and risk of CVD may vary in populations with different risks of CVD. Relative to other countries, the UK population is at high risk of CVD; however, sub-populations within the UK may exhibit different risk.
- 1.10 SACN, therefore, endorsed the population recommendation to eat at least two portions of fish per week, of which one should be oily, and agreed that this recommendation should also apply to pregnant women. Two portions of fish per week, one white and one oily, contain approximately 0.45g/d LC n-3 PUFA.
- 1.11 An increase in population oily fish consumption to one portion a week, from the current levels of about a third of a portion a week, would confer significant public health benefits in terms of reduced risk of CVD. There is also evidence that increased fish consumption might have beneficial effects on fetal development.
- 1.12 SACN emphasized that this recommendation represents a minimal and achievable average population goal and does not correspond to the level of fish consumption required for maximum nutritional benefit. The evidence to support benefit at higher levels of consumption is insufficient to enable accurate quantification.
- 1.13 It would be inappropriate to discourage fish consumption at levels higher than the dietary recommendation unless there was an upper limit beyond which people should not consume.

### **The toxicological considerations**

- 1.14 The current key concerns relate to the dioxins and dioxin-like polychlorinated biphenyls (PCBs) and to methylmercury. In addition, there is a need to keep under review the concentrations in fish of other persistent organic pollutants such as the brominated flame retardants (BFRs).
- 1.15 It should be noted that the dioxins and dioxin-like PCBs and the BFRs of concern are persistent lipophilic compounds that accumulate in lipid. They are therefore particularly likely to be present in oily fish. In contrast, methylmercury is not specifically found in oily fish. It is present in the marine environment and accumulates up the food chain in fish, with levels being highest in large predatory species.
- 1.16 Tolerable Daily or Weekly Intakes are established to protect consumers from the adverse effects associated with chemical contaminants in food. The tolerable intake is set to protect against the most sensitive toxic effects in the most susceptible subgroups of the population, taking into account human variability, and is defined as an amount that can be consumed daily over an entire lifetime without appreciable risk to health. It is not a threshold for risk and there is uncertainty about the degree of risk above the tolerable intake. The most sensitive individuals may be at risk from a small exceedance, whereas many individuals will not be. Any risk is likely to increase with the degree and duration of exceedance of the tolerable intake, but COT has not considered it possible to quantify the risk.
- 1.17 There is currently no established methodology for risk-benefit analysis that can be applied to fish. This report therefore focuses on whether separate intake guidelines can be developed for different population groups. Such an approach would support dietary advice to consumers that would allow individuals at lesser risk of the toxic effects to maximize the nutritional benefits.
- 1.18 The most sensitive effects of chemical contaminants in fish relate to developmental changes in the unborn child, resulting from maternal exposure. On the basis that it takes about 5 half-lives to reach steady state body burden, for cumulative contaminants a woman's exposure before

pregnancy is likely to be more important for the total body burden than intake during pregnancy.

### *Methylmercury*

- 1.19 The half-life of methylmercury is about 70 days in humans; fetal exposure is therefore likely to be determined by maternal exposure in the year leading up to pregnancy.
- 1.20 In December 2003, COT considered levels of mercury in fish (see Annex 3) and concluded:
- a methylmercury intake of 3.3µg/kg bodyweight per week may be used as a guideline to protect against non-developmental adverse effects.
  - the 2003 JECFA PTWI<sup>1</sup> of 1.6µg/kg bodyweight per week is sufficient to protect against neurodevelopmental effects in the fetus. This PTWI should be used in assessing the dietary exposure to methylmercury of women who are pregnant, and who may become pregnant within the following year.
  - a guideline of 3.3µg/kg bodyweight per week is appropriate in considering intakes by breastfeeding mothers as the intake of the breast-fed infant would be within the new PTWI of 1.6µg/kg bodyweight per week.
  - consuming one weekly 140g portion of either shark, swordfish or marlin would result in a dietary methylmercury exposure close to or above 3.3µg/kg bodyweight per week in all age groups. We *consider* that this consumption could be harmful to the fetus of women who are pregnant or become pregnant within a year, but would not be expected to result in adverse effects in other adults.

<sup>1</sup> Provisional Tolerable Weekly Intake established by the Joint FAO/WHO Expert Committee on Food Additives (JECFA)

- the mercury content of tuna is lower than that of shark, swordfish or marlin, but higher than that of other commonly consumed fish. We consider that consumption of two 140g portions of fresh tuna, or four 140g portions of canned tuna, per week, before or during pregnancy would not be expected to result in adverse effects on the developing fetus.
- 1.21 On the basis of the COT opinion, the FSA has advised that pregnant women, women intending to become pregnant and children under 16 should avoid eating shark, marlin and swordfish. One weekly portion of these fish would not be harmful for other adults. Pregnant women and women intending to become pregnant may eat up to four medium-size cans or two tuna steaks a week. Children and other adults do not need to restrict the amount of tuna they eat.

### *Dioxins and dioxin-like PCBs*

- 1.22 In 2001, COT set a tolerable daily intake (TDI) of 2 pg WHO-TEQ/kg bw per day<sup>2</sup>, to protect against effects on the developing male reproductive system resulting from the maternal body burden of dioxins (see Annex 5). This TDI was considered adequate to protect against other possible effects of dioxins, such as cancer and cardiovascular effects.
- 1.23 The Inter-Committee Subgroup established a guideline level to protect against non-developmental effects of dioxins and dioxin-like PCBs, in line with the approach taken by COT for methylmercury.
- A guideline level of 8 pg TEQ/kg bodyweight per day is appropriate in considering intakes in relation to the most sensitive and relevant non-development effect of dioxins – increased cancer risk.

2 Toxic Equivalency Factors (TEFs) allow concentrations of the less toxic dioxin-like compounds to be expressed as a concentration equivalent to the most toxic dioxin - 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). These toxicity-weighted concentrations are then summed to give a single value, which is expressed as a Toxic Equivalent (TEQ). The system of TEFs used in the UK and a number of other countries is that set by the World Health Organization (WHO), and the resulting overall concentrations are referred to as WHO-TEQs

- 1.24 Because the dioxins and dioxin-like PCBs have half-lives of several years in humans, exposure throughout life up to time of pregnancy will determine the exposure to the fetus. The Inter-Committee Subgroup, therefore, agreed that the TDI should be used in considering dietary exposure to dioxins of females up to and including reproductive age. The guideline level could be used for older women and for males, and, because it is derived from a lifetime study, it also applies to young males.
- 1.25 The Subgroup also noted that an intake of twice the TDI for up to 12 months had a minimal effect on the body burden and was therefore not expected to result in adverse effects.
- 1.26 The Inter-Committee Subgroup were provided with estimates of dietary intake of dioxins and dioxin-like PCBs by an average 60kg adult from a range of oily fish together with intake from the rest of the diet. Overall, these data indicated that consumption of about two portions of oily fish per week could be consumed without appreciable exceedance of the TDI. Four portions of oily fish could be consumed per week without exceeding the guideline level. Fish containing higher concentrations of dioxins, such as herring, should be consumed less frequently than fish with lower amounts, such as trout. Salmon and mackerel have intermediate dioxin content.
- 1.27 The Subgroup noted uncertainty with respect to the effects of obesity, or of rapid weight loss during dieting, on the body burden, although it recognized that these factors would influence circulating blood concentrations of dioxins and dioxin-like PCBs. There is a need for information on whether the uncertainty factor incorporated into the TDI and guideline level is adequate to allow for this aspect of human variability.

## Conclusions

- 1.28 The majority of the UK population does not consume enough fish, particularly oily fish, and should be encouraged to increase consumption. The Inter-Committee Subgroup endorsed the COMA population guideline recommendation that people should eat at least two portions of fish a week,

of which one should be oily. Consumption of this amount would probably confer significant public health benefits to the UK population in terms of reducing CVD risk. There may also be beneficial effects on fetal development.

- 1.29 The Inter-Committee Subgroup stated that this recommendation should also apply to pregnant and lactating women, subject to the restrictions on certain fish – marlin, swordfish, shark and, to a lesser extent, tuna – due to methylmercury contamination.
- 1.30 With regard to high levels of oily fish consumption and the dioxins and dioxin-like PCB contaminants therein, the evidence base is insufficient to conduct a quantitative risk-benefit analysis. Separate intake guidelines were, therefore, developed for different population groups.
- 1.31 The Inter-Committee Subgroup noted that it might be beneficial for some subgroups to consume more than the guideline recommendation, but was unable to identify a precise level. It was decided that a guideline range for oily fish consumption, based on the nutritional and toxicological considerations (levels at which there would be clear benefits without undue risk), should be recommended.
- 1.32 The guideline ranges for oily fish consumption were for:
  - Women of reproductive age and girls should aim to consume within the range of one to two portions of oily fish a week, based on maintaining consumption of dioxins and dioxin-like PCBs below the TDI of 2 pg WHO-TEQ/kg bodyweight per day.
  - Women past reproductive age, boys and men should aim to consume within the range of one to four portions of oily fish a week, based on maintaining consumption of dioxins and dioxin-like PCBs below the guideline value of 8 pg WHO-TEQ/kg bodyweight per day.
- 1.33 It was noted that consumers would need to be provided with information on the levels of dioxins and dioxin-like PCBs present in different species

of commonly consumed fish. This would enable consumers to make informed choices on the number and type of fish consumed per week.

- 1.34 The Inter-Committee Subgroup emphasized that exceeding the designated ranges over the short-term was not deleterious, but long-term exceedances could have deleterious effects in sensitive individuals. In the case of pregnant and lactating women, for example, a woman who had not consistently exceeded the guideline range previously, could increase her oily fish consumption throughout pregnancy and lactation above the guideline range (e.g. to 2-3 portions of oily fish a week) without detrimental effects.