**Table 1: Estimated mean and high level dietary intakes of mercury from salmon, prawns, canned tuna and the whole diet.**

| Consumer group | Mercury Intake - µg/kg bw/week [a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Salmon [b] | | Prawns [b] | | Canned Tuna [b] | | Whole Diet [c,d] | |
| | Mean | 97.5% | Mean | 97.5% | Mean | 97.5% | Mean | 97.5% |
| Infants | 0.01 | 0.01 | - [e] | - [e] | 0.04 | 0.13 | 0.04 | 0.13 |
| Toddlers | 0.18 | 0.53 [f] | 0.13 | 0.45 [f] | 0.84 | 2.45 | 0.56 | 2.17 |
| Young People aged 4 – 6 | 0.18 | 0.39 [g] | 0.09 | 0.34 [f] | 0.53 | 1.61 | 0.55 | 1.82 |
| Young People aged 7 – 10 | 0.11 | 0.36 [f] | 0.06 | 0.15 [f] | 0.39 | 1.26 | 0.41 | 1.40 |
| Young People aged 11 – 14 | 0.09 | 0.23 [g] | 0.04 | 0.13 [f] | 0.32 | 0.98 | 0.29 | 1.05 |
| Young People aged 15 – 18 | 0.08 | 0.15 [g] | 0.04 | 0.11 | 0.27 | 0.68 | 0.25 | 0.84 |
| Adults | 0.10 | 0.32 | 0.04 | 0.14 | 0.30 | 1.05 | 0.31 | 1.19 |
| Adults – Women only | 0.11 | 0.32 | 0.05 | 0.16 | 0.34 | 1.19 | 0.34 | 1.19 |

a. Consumption data for salmon, prawns and tuna are taken from the following sources:
   - 2002 National Diet and Nutritional Survey: adults aged 19 to 64 years. [38]
   - Food and Nutrient Intakes of British Infants Aged 6-12 Months [35]
   - National Diet and Nutrition Surveys Children Aged 1.5 – 4.5 years.[37]
   - National Diet and Nutrition Survey: young people aged 4-18 years. Volume 1 report of the diet and nutrition survey.[36]
b. Mercury intake from eating the named fish only, for the mean and 97.5$^{th}$ percentile consumers.
c. Mercury exposure from the whole diet for individuals of the whole study population, including those that eat the named fish (taken from the 2000 Total Diet Study[39]). The whole diet mercury exposure does not equal the sum of the mercury exposures from the named fish and other foods in the typical UK diet.
d. The measurement of mercury does not distinguish between inorganic and organic mercury. Therefore although methylmercury is the major contributor to mercury intake from fish, the estimate of intake from the whole diet also includes inorganic mercury.
e. No infant consumption data were recorded for prawns in the Infant Survey.
f. Based on consumption data for fewer than 60 recorded consumers, therefore exposures to be regarded with caution.
g. Based on consumption data for fewer than 20 recorded consumers, therefore exposures to be regarded with extreme caution.

These estimates have been revised to incorporate up-to-date consumption and occurrence data for the rest of the diet from the TDS.

**Table 2: Mercury intake from one weekly portion of shark, swordfish, marlin, fresh tuna or canned tuna.**

| Age group (years) | Body Weight (kg) | Av. Portion Size [a] (g) | Weekly mercury intake assuming one portion of fish per week [b] (µg/kg bw/week) | | | | |
|---|---|---|---|---|---|---|---|
| | | | Shark | Swordfish | Marlin | Fresh Tuna | Canned Tuna |
| 1.5 – 4.5 | 14.5 | 50 | 5.24 | 4.62 | 3.79 | 1.38 | 0.66 |
| 4 – 6 | 20.5 | 60 | 4.44 | 3.90 | 3.22 | 1.17 | 0.56 |
| 7 – 10 | 30.9 | 85 | 4.17 | 3.69 | 3.04 | 1.10 | 0.52 |
| 11 – 14 | 48.0 | 140 | 4.44 | 3.92 | 3.21 | 1.17 | 0.55 |
| 15 – 18 | 63.8 | 105 | 2.51 | 2.21 | 1.82 | 0.66 | 0.31 |
| Adults | 70.1 | 140 | 3.04 | 2.68 | 2.20 | 0.80 | 0.38 |

a. The average portion size that each age group of the population would consume at a single meal event for fish consumption, as recorded in the following National Diet and Nutrition Surveys (NDNS):

- 1995 National Diet and Nutrition Survey: Children aged one-and-a-half to four-and-a-half years [37].
- 2000 National Diet and Nutrition Survey: young people aged 4 to 18 years [36].
- 1990 The Dietary and Nutritional Survey of British Adults[38].

b. This intake estimate does not include the intake from the rest of the diet, which is estimated to be 0.04 µg/kg bw/day (0.28 µg/kg bw/week)[39].

## References


1 Food Standards Agency (2002): Mercury in imported fish and shellfish and UK farmed fish and their products. *Food Surveillance Information Sheet* **40/03.** http://www.food.gov.uk/science/surveillance/fsis-2003/fsis402003

2 The National Diet and Nutrition Survey (2000-2001): adults aged 19 to 64 years - Blood mercury results (unpublished).

3 COT (2002). 2002-04: COT statement on Mercury in Fish and Shellfish

4 Clarkson, T. W. (2002). The three modern faces of mercury. *Environ. Health Perspect.* **110 (1):** 11-23

5 Clarkson T.W, Magos L. and Myers G.J. (2003), The toxicology of mercury – Current exposures and clinical manifestations. *N Engl J Med* **349**:1731-1737.

6 Ministry of Agriculture, Fisheries and Food (1998): Survey of the concentrations of metals and other elements in marine fish and shellfish. *Food Surveillance Information Sheet* **151** http://archive.food.gov.uk/maff/archive/food/infsheet/1998/no151/151fish.htm

7 WHO (1972). Evaluation of Mercury, Lead, Cadmium and the food additives Amaranth, Diethylpyrocarbonate and Octyl Gallate. FAO Nutrition Meetings Report Series, No. 51A: WHO Food Additives Series No. 4

8 WHO (1989). Toxicological evaluation of certain food additives and contaminants. Cambridge, Cambridge University Press. (WHO Food Additives Series, No. 24).

9 WHO (2000). Safety Evaluation of Certain Food Additives and Contaminants. WHO Food Additives Series 44

10 Grandjean, P., Weihe, P., White, R. F., Debes, F., Araki, S, Yokoyama, K., Murata, K., Sorensen, N., Dahl, R., Jorgensen, P. J. (1997). Cognitive deficit in 7-year-old children with prenatal exposure to methylmercury. *Neurotoxicol. Teratol.* **19:** 417-428

11 Crump, K.S., Van Landingham, C., Shamlaye, C., Cox, C., Davidson, P.W., Myers, G.J., Clarkson, T.W. (2000). Benchmark concentrations for methylmercury obtained form the Seychelles Child Development Study. *Environ. Health Perspect.* **108:** 257-263

12 Davidson, P.W., Myers, G., Cox, C., Axtell, C., Shamlaye, C., Sloane-Reeves, J., Cernichiari, E., Needham, L., Choi, A., Wang, Y., Berlin, M., Clarkson, T. W. (1998). Effects of prenatal and postnatal methylmercury exposure from fish consumption on neurodevelopment. Outcomes at 66

months of age in the Seychelles Child Development Study. *JAMA* **280:** 701-707

13 Myers, G. J., Davidson, P. W., Shamlaye, C. F. (1998). A review of methylmercury and child development. *Neurotoxicology* **19:** 313-328

14 Budtz-Jorgensen, E., Keiding N., Grandjean P. and White RF. (1999). Methylmercury neurotoxicity independent of PCB exposure. *Environmental Health Perspectives*, **107 (5):** 236 – 237

15 Kjellstrom, T., Kennedy, P., Wallis, S., Stewart, A., Friberg, L., Lind, B., Witherspoon, P., Mantell, C. (1989). Physical and mental development of children with prenatal exposure to mercury from fish. Stage 2: Interviews and psychological tests at age 6. National Swedish Environmental Protection Board, Report 3642, Solna, Sweden

16 EPA (U.S. Environmental Protection Agency). (1997). Mercury Study Report to Congress. Vol. IV: An assessment of exposure to mercury in the United States. EPA-452/R-97-006. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards and Office of Research and Development

17 National Research Council (2000), Toxicological effects of Methylmercury. National Academy Press, Washington, DC.

18 WHO (2003). Safety Evaluation of Certain Food Additives and Contaminants; Methylmercury. Summary and Conclusions of the 61st JECFA meeting. ftp://ftp.fao.org/es/esn/jecfa/jecfa61sc.pdf (07/10/2003)

19 Myers, G.J., Davidson, P.W., Coc, C., Shamlaye, C.F., Palumbo, D., Cernichiari, E., Sloane-Reeves, J., Wilding, G.E., Kost, J., Huang, L.S. and Clarkson, T.W. (2003). Prenatal methylmercury exposure from ocean fish consumption in the Seychelles Child development study. *The Lancet.* **361:** 1686-1692.

20 Grandjean, P., Weihe, P., Burse, V.W., Needham, L.L., Storr-Hansen, E., Heinzow, B., Debes, F., Murata, K., Simonsen, H., Ellefsen, P., Budtz-Jorgensen, E., Keiding, N. & White, R.F. (2001) Neurobehavioral deficits associated with PCB in 7-year-old children prenatally exposed to seafood neurotoxicants. *Neurotoxicol. Teratol.* **23**: 305-317.

21 Grandjean, P., Budtz-Jorgensen, E., Steuerwald, U., Heinzow, B., Needham, L.L., Jorgensen, P.J. & Weihe, P. (2003). Attenuated growth of breast-fed children exposed to increased concentrations of methylmercury and polychlorinated biphenyls. *FASEB J.* **17:** 699-701.

22 Stewart, P.W., Reihman, J., Lonky, E.I., Darvill, T.J. & Pagano, J. (2003). Cognitive development in preschool children prenatally exposed to PCBs and MeHg. *Neurotoxicol. Teratol.* **25**: 11-22.

23 Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for Mercury. 1999

24 Budtz-Jorgensen, F., Keiding, N. & Grandjean, P. (1999) Benchmark modeling of the Faroese methylmercury data. Final Report to US EPA, 1-13.

25 Budtz-Jorgensen, F., Grandjean, P., Keiding, N., White, R. & Weihe, P. (2000) Benchmark dose calculations of methylmercury-associated neurobehavioural deficits. *Tox. Lett.* 112-113, 193-199.

26 Budtz-Jorgensen, F., Keiding, N. & Grandjean, P. (2001) Benchmark dose calculation from epidemiological data. *Biometrics* **57:** 698-706.

27 Rice, D., Schoeny, R. & Mahaffey, K. (2003) Methods and rationale for the derivation of a reference dose for methylmercury by the U.S. EPA. *Risk Analysis* **23:** 107-115.

28 WHO (1976). Environmental Health Criteria 1. Mercury. United Nations Environment Programme and the World Health Organisation. Geneva

29 Doherty, R.A. and Gates, A.H. (1973). Epidemic human methylmercury poisoning; application of a mouse model system. *Paediatric Research,* **7(4):** 319/91

30 Sundberg, J. Jonsson, S., Karlsson, M.O. and Oskarsson, A. (1999). Lactational exposure and neonatal kinetics of methylmercury and inorganic mercury in mice. *Toxicol. Appl. Pharmacol.* **154:** 160 – 169

31 Amin-Zaki, L., Majeed, M.A., Greenwood, M.R., Elhassani, S.B., Clarkson, T.W. and Doherty, R.A. (1981). Methylmercury poisoning in the Iraqi suckling infant: a longitudinal study over five years. *J. Appl. Toxicol.* **1(4):** 210-214

32 Spyker, D.A, and Spyker J.M. (1977). Response model analysis of cross-fostering studies: Prenatal versus postnatal effects on offspring exposed to methylmercury dicyandiamide. *Toxicol. Appl. Pharmacol*, **40 (3):** 1977 511-527

33 Grandjean, P., Weihe, P., Needham, L.L., Burse, V.W., Patterson, D.G., Sampson, E.J., Jorgensen, P.J., Vahter, M. (1995). Relation of a seafood diet to mercury, selenium, arsenic, and polychlorinated biphenyl and

other organochlorine concentrations in human milk. *Environ. Res.* **71 (1):** 29-38

34 Grandjean, P., Weihe, P., White, R.F. (1995a). Milestone development in infants exposed to methylmercury from human milk. *Neurotoxicol.* **16 (1):** 27-33

35 Mills, A. & Tyler, H. (1992). Food and Nutrient Intakes of British Infants Aged 6-12 Months, HMSO

36 Gregory, J., Lowe, S., Bates, C.J., Prentice, A., Jackson, L.V., Smithers, G., Wenlock, R., and Farron, M. (2000). National Diet and Nutrition Survey: young people aged 4 to 18 years. Volume 1: Report of the diet and nutrition survey. London: TSO

37 Gregory, J., Collins, D.L., Davies, P.S.W., Hughes, J.M. and Clarke, P.C. (1995). National Diet and Nutrition Survey: Children aged one-and-a-half to four-and-a-half years. Volume 1: Report of the diet and nutrition survey. London, HMSO

38 Henderson L., Gregory J. and Swan, G. (2002). The National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 1: Types and quantities of foods consumed. TSO, UK.

39 Food Standards Agency (2004). 2000 Total Diet Study. *Food Surveillance Information Sheet* (to be published)

# Mercury Levels in Fish and Shellfish

## Recent Survey

| SPECIES | MEAN (MG/KG) | RANGE | NO. OF SAMPLES |
|---|---|---|---|
| **Fish** | | | |
| Halibut | 0.290 | 0.036-0.617 | 2 |
| Hoki | 0.186 | 0.065-0.307 | 8 |
| Monkfish | 0.198 | 0.096-0.300 | 2 |
| Orange Roughy | 0.595 | 0.527-0.647 | 6 |
| Other | 0.105 | 0.006-0.664 | 12 |
| Pollack | 0.012 | 0.007-0.020 | 4 |
| Salmon | 0.050 | 0.029-0.079 | 14 |
| Sea Bass | 0.065 | 0.030-0.094 | 4 |
| Sea Bream | 0.053 | 0.051-0.056 | 4 |
| Shark | 1.521 | 1.006-2.200 | 5 |
| Marlin | 1.091 | 0.409-2.204 | 4 |
| Swordfish | 1.355 | 0.153-2.706 | 17 |
| Trout | 0.060 | 0.014-0.103 | 14 |
| Tuna | 0.401 | 0.141-1.500 | 34 |
| **Shellfish** | | | |
| Exotic prawns | 0.025 | 0.006-0.047 | 14 |
| Lobster | 0.075 | 0.009-0.231 | 4 |
| Mussels | 0.030 | 0.017-0.041 | 4 |
| Other | 0.038 | 0.003-0.186 | 9 |
| Prawns | 0.048 | 0.013-0.249 | 14 |
| Squid | 0.011 | 0.003-0.036 | 9 |

Source: University of Bristol Survey 'Mercury in imported fish and shellfish and UK farmed fish and their products' Unpublished.

## Previous Survey

| SPECIES | MEAN (MG/KG) | RANGE | NO. OF SAMPLES |
|---|---|---|---|
| **Marine Fish** | | | |
| Cod | 0.066 | 0.029-0.098 | 10 |
| Haddock | 0.043 | 0.023-0.072 | 25 |
| Herring | 0.091 | 0.044-0.13 | 9 |
| Mackerel | 0.054 | 0.024-0.10 | 14 |
| Plaice | 0.056 | 0.029-0.086 | 15 |
| Red Fish | 0.12 | 0.12-0.12 | 2 |
| Whiting | 0.14 | 0.029-0.26 | 15 |
| Cod fish fingers | 0.016 | 0.006-0.025 | 3 |
| **Shellfish** | | | |
| Brown shrimps | 0.065 | 0.061-0.068 | 2 |
| Cockles | 0.026 | 0.013-0.046 | 3 |
| Crab | 0.092 | 0.051-0.13 | 2 |
| Lobsters | 0.29 | 0.15-0.49 | 4 |
| Mussels | 0.063 | 0.028-0.11 | 4 |
| Pink Shrimps | 0.089 | 0.079-0.099 | 2 |
| Queen Scallops | 0.017 | 0.016-0.018 | 2 |
| Squid | 0.040 | 0.016-0.058 | 3 |
| Scallops | 0.010 | 0.008-0.011 | 3 |
| Scampi | 0.11 | 0.11-0.12 | 2 |
| Winkles | 0.037 | 0.026-0.049 | 4 |

Source: FSIS 151 'Concentrations of metals and other elements in marine fish and shellfish' May 1998.