

5. DIETARY INTAKE OF MERCURY

5.1 Toxicology

Mercury is a toxic element found mostly in fish and fishery products. Methylmercury, the main form in which mercury is present in seafood is the most toxic among mercury species. The methylmercury content in fish and shellfish varies, but it is generally assumed that over 90% is in the form of methylmercury. It may induce alterations in the normal development of the brain of infants and may, at higher levels, induce neurological changes in adults. Children exposed to methyl mercury prior to birth may experience negative effects on their mental development. Therefore, the levels of mercury and methylmercury in food should be as low as reasonably achievable, (taking into account that for physiological reasons certain fish species concentrate mercury more easily in their tissues than others).(ref.1-7)

5.2 Recommendations on intake limitations

A PTWI of 0.005 mg/kg (5 µg/kg) bodyweight have been decided for total mercury. This is equal to 0.35 mg/week (350 µg/week) for a person weighing 70 kg. The average intake of total mercury by an adult in the Member States is, according to current information, 5.53 µg/day, which is equal to 38.7 µg/week.

Table 5. 1. Mercury. Consumption of food in g/day by the mean adult population in the Member States. The figures are based on products for which occurrence data are available.

Food	BE	DK	FI	FR	DE	HE	IR	IT	NL	NO	PT	SE	UK
Milk, milk products	238	357				112							281
Condensed and milk powder, cheese, yoghurt		33			41								60
Fats and oils		48			21								27
Edible ice													
Fruits and vegetables		421		353	352	0.5*			360				379
Confectionary		30			5.9								
Cereals and bakery wares		217		63**	188	23			220				209
Meat		136			175	37	88						88
Offal						1.6	0.87				2.2		1
Fishmeat	13	23	53	30	16	36	20	32	10	70	40	30	14
Bivalves, crustaceans and cephalopods	1.8			4.7	0.8	5.2	0.05			10	10		
Eggs		21			33								14
Sweeteners					13						31		63
Salt and spices				9.3	2.3				79				
Beverages		2003		1091	376								937
Ready to eat													2
Composite food									282				
Sum	253	3289	53	1551	1227	215	109	32	951	80	83	30	2075

* dried fruit. ** excluding bakery wares

SCOOP 3.2.11 – Intake of As, Cd, Pb and Hg

In its sixtieth meeting in Rome, (10-19 June 2003), JECFA established a new PTWI-value for methylmercury, corresponding to 1.6 µg/kg bw, which covers also pregnant women and their fetuses (the previous value was 3.3 µg/kg bw, and did not protect this risk group).

5.3 Intake of mercury by the mean adult population

Thirteen Member States submitted data for the mean adult population (BE for 14-18 year olds).

In addition, several Member States submitted data for other population groups (Table 1.1)

The Tables 5.2 - 5.4 report the intakes for 13 food categories.

Table 5.2 Mercury daily intake (µg/day). Mean Adult population.

Food	BE	DK	FI	FR	DE	HE	IR	IT	NL	NO	PT	SE	UK	Mean
Milk and dairy products	0.13	0.38			0.165								0.23	0.23
Fats and oils		0.02			0.12								0.08	0.07
Fruits and vegetable		0.61		3.49	3.27				1.05				0.29	1.74
Cereals and bakery ware		0.58		1.16 **	1.32				0.42				0.62	0.82
Meat and offal		0.20			1.62		0.42				0.09		0.21	0.51
Fish and fish products	2.53	0.96	6.2	2.73	2.80	4.51	0.92	8.6	0.19	3.34	13.1	2.7	1.00	3.81
Bivalves, cephalopoda, crustaceans, squid	0.12			0.15	0.02	0.66	0.03			0.72	0.80			0.36
Eggs		0.03			0.17								0.02	0.07
Sweeteners					0.05						0.39		0.19	0.21
Salts, spice				0.49	0.02				0.09					0.2
Beverages		0.73		0.45 *	0.36*								0.37	0.46
Ready to eat													0.01	0.01
Composite food									0.04					0.04
Sum	2.78	3.5	6.2	8.48	9.91	5.17	1.37	8.6	1.79	4.06	14.4	2.7	3.02	5.53

* Including drinking water. ** Excluding bakery ware

No Country reports intake data for all the food categories. DE presents the higher number of food categories (11/13), IT and SE the lower (1/13).

Table 5.3 Mercury. Weekly intake (µg/week). Mean Adult population.

Food	BE	DK	FI	FR	DE	HE	IR	IT	NL	NO	PT	SE	UK	Mean
Milk and dairy products	0.88	2.66			1.15								1.61	1.57
Fats and oils		0.14			0.86								0.56	0.52
Fruit and vegetable		4.27		24.4	22.9				7.35				2.03	12.2
Cereals and bakery ware		4.06		8.15* *	9.21				2.94				4.34	5.74
Meat and offal		1.40			11.4		2.94				0.63		1.47	3.56
Fish	17.7	6.72	43.4	19.1	19.6	31.6	6.44	60.2	1.33	23.4	91.7	18.9	7.00	26.7
Bivalves, cephalopods, crustaceans, squid	0.83			1.06	0.12	4.62	0.21			5.04	5.6			2.50
Eggs		0.21			1.17								0.14	0.51
Sweeteners					0.35						2.73		1.33	1.47
Salts and spices				3.44	0.14				0.63					1.4
Beverages		5.11		3.12*	2.52								2.59	3.26
Ready to eat													0.07	0.07

SCOOP 3.2.11 – Intake of As, Cd, Pb and Hg

Composite food										0.28							0.28
Sum	19.4	24.5	43.4	59.3	69.4	36.2	9.59	60.2	12.6	28.4	101	18.9	21.1	38.7			

* Including drinking water. ** Excluding bakery wares

Table 5.4 Mercury. Weekly Intake in % PTWI, by the Mean Adult Population*

Food	BE	DK	FI	FR	DE	HE	IR	IT	NL	NO	PT	SE	Mean
Mean body weight	60	72	77.1	66.4	70.5	70	75	70	65.8	73	70	73.7	70.3
Milk and dairy products	0.29	0.74			0.33								0.45
Fats and oils		0.04			0.24								0.14
Fruit and vegetable		1.19		7.36	6.49				2.23				4.32
Cereals and bakery ware		1.13		2.46	2.62				0.89				1.78
Meat and offal		0.39			3.22		0.78				0.18		1.14
Fish	5.90	1.87	12.0	5.76	5.56	9.02	1.72	17.2	0.40	6.41	26.2	5.13	8.10
Bivalves, cephalopods, crustaceans, squid	0.28			0.32	0.04	1.32	0.06			1.38	1.6		0.71
Eggs		0.06			0.33								0.19
Sweeteners					0.10						0.78		0.44
Salts e spice				1.04	0.04				0.19				0.42
Beverages		1.42		0.85	0.72								1.00
Ready to eat													
Composite food									0.09				0.99
Sum	6.47	6.81	12.1	17.78	19.7	10.3	2.56	17.2	3.8	7.79	28.8	5.13	18.78

*UK uses consumer intake estimates for comparison with safety guidelines.

The values of the sum of total mercury intakes, for all countries, are in the range 9.6 µg/week (IR, 3 food categories), and 100.7 µg/week (PT, 4 food categories). This corresponds to 2.56% – 28.8%) of the PTWI, assuming an average weight of 70 kg for a Member States adult. Eleven countries have mercury levels less than 60.3 µg/week, while 2 countries (DE, PT) have respectively 69.4 µg/week and 100.7 µg/week. Regarding the intake for drinking water, it was calculated out of the intakes sum. Two countries present water intake data: FR (0.29 µg/week), DE (0.28 µg/week, including the consumption of mineral water)

The mean intake of methylmercury from fish, bivalves, cephalopods, crustaceans and squid is specified in tables 5.2 – 5.3. These data can be used to calculate the intake of methylmercury in relation to the PTWI of 1.6 µg/kg body weight/week for methylmercury (WHO, 2003). The mean intake of mercury from fish and seafood is 29.2 µg/week, taking the mean values for all countries according to Table 5.3. If it is assumed that all of the mercury present in fish is present as methylmercury, the mean intake corresponds to 26% of the PTWI for methylmercury for a person with a body weight of 70 kg. In Tables 5.28 and 5.29 daily mercury intake in consumers only, mean and high level, reported by the UK are shown. From these data it can be calculated that in UK, consumers only, methylmercury intake from fish and shellfish corresponds to 13% of the PTWI for methylmercury. For consumers only, high level, methylmercury intake from fish and shellfish corresponds to 41% of the PTWI for methylmercury. In NO the methylmercury intake by mean consumers corresponds to 73% of the PTWI for methylmercury, whereas for high consumers, methylmercury intake is more than twice the PTWI for methylmercury (e.g. $(11.0+1.35 \mu\text{g}/\text{day}) \times 7/118 = 0.73$; $(34.06+4.25) \times 7/118 = 2.25$). The method used in the Norwegian intake calculation (i.e. intake based on single

point estimates for consumption of each of the relevant foods combined with single point estimates for Hg-concentration in those foods) is known to overestimate the intake, in particular the high-level intakes. However, the results from the SCOOP task indicate that there is a risk that population-groups with a high consumption of fish and seafood may have intakes of methylmercury that are close or even exceed the PTWI of 1.6 µg/kg body weight/week

5.4 Intake of mercury by children: Mean population

Intake data were reported by FR and DE (BE reported intake data for 14-18 year olds, but they are included in the tables for the mean adult population). The data are shown in Table 5.5, together with data on their percentage of the PTWI for total mercury. Since children have a lower body mass, their body burden per kg bodyweight will generally be larger than that for adults.

The total mercury dietary intake for children in FR is 41.02 µg/week, corresponding to 25.96% of the PTWI (31.6 kg x 5 = 158 µg/week). The dietary intake of the mean adult population in France is 59.4 µg/week, corresponding to 17.88% of the PTWI. The mercury dietary intakes for two children groups in DE are 38.95 and 52.55 µg/week, corresponding respectively to 37.15% and 25.66% of the PTWI (21 kg x 5 = 105 µg/week-age 4-6 years; 41 kg x 5 = 205 µg/week-age 10-12 years). The dietary intake of the mean adult population in Germany is 69.37 µg/week, corresponding to 19.7 % of the PTWI.

The intake of mercury from fish and shellfish can also be compared with the PTWI for methylmercury. For a 4-6 year-old child weighing 21 kg, the PTWI for methylmercury corresponds to 33.6 µg. Similarly, for a 10-12 year-old child the PTWI for methylmercury

Table 5.5. Total mercury. Intake by children in various age brackets. Mean Population.

	Daily intake, µg			Weekly intake, µg			% of PTWI		
	Age bracket, year			Age bracket, year			Age bracket, year		
	3-14	4-6	10-12	3-14	4-6	10-12	3-14	4-6	10-12
Food	FR	DE	DE	FR	DE	DE	FR	DE	DE
Milk and milk products									
Condensed, powder milk, cheese, yoghurt		0.081	0.092		0.567	0.637		0.54	0.31
Fats and oils		0.076	0.106		0.532	0.742		0.51	0.36
Fruits and vegetables	2.16	1.81	2.39	15.12	12.67	16.74	9.57	12.11	8.17
Cereals and bakery wares	1.45	0.907	1.24	10.15	6.349	8.68	6.42	6.05	4.23
Meat		0.80	1.267		5.6	8.87		5.33	4.33
Offal		0.004	0.008		0.028	0.056		0.03	0.027
Fish and fish products	1.70	1.273	1.739	11.9	8.91	12.17	7.53	8.48	4.86
Bivalve, crustaceans and cephalopods	0.06	0.004	0.005	0.42	0.028	0.035	0.26	0.03	0.017
Eggs		0.107	0.128		0.75	0.896		0.71	0.44
Sweeteners		0.033	0.036		0.23	0.254		0.21	0.12
Salt and spices	0.34	0.012	0.016	2.38	0.084	0.111	1.51	0.018	0.054
Beverages	0.147	0.453	0.478	1.03	3.169	3.345	0.65	3.02	1.63
Sum	5.86	5.56	7.51	41.02	38.95	52.55	24.4	37.15	25.66

corresponds to 65.6 µg. Using the data from FR and DE in Table 5.5, the percentage of PTWI for methylmercury for children is 26% and 19% for children aged 4-6 and 10-12 years, respectively (as a worst case assuming that all mercury is methylmercury).

Intake data in Table 5.30, shows daily mercury intake in children, consumers only, mean or high level, or mean population, high level. Using these data for comparison with PTWI for methylmercury, gives that PTWI is reached or exceeded in children (e.g. for 10-12 year-old children; 9.64 x 7/65.6).

5.5 Legislation

In Table 5.6 the MLs for mercury, as defined in The Commission Regulation (EC) No 466/2001, are compared with available occurrence data from the Member States. The occurrence data were collated to give as realistic a picture as possible. They are to some extent an approximation based on many data sets and do not claim to be an “absolute” truth.

Table 5.6. Mercury. Maximum Levels (ML) in mg/kg, as defined in Commission Regulation (EC) No 466/2001, and compared with occurrence data from the Member States.

Product	ML	BE	DK	FI	FR	DE	HE	IR	IT	NL	NO	PT	SE	UK
3.3.1	0.5			0.024- 0.255 <0.005/ 1.35	0.060 <0.00003 /0.857		<0.01- 0.286 0.0015/ 3.70	0.005- 0.34 <0.01/ 0.34*	0.07-0.27 0.05/ 0.42	0.01-0.14 0.005/ 0.56	<0.05- 0.278 0.01/ 3.14		0.16 0.01/ 1.26	
3.3.1.1	1.0			0.16- 0.412 <0.01/ 0.849	0.381 <0.004/ 30		0.377 0.268/ 0.432	0.030- 0.1667 0.030/ 0.55**	0.21- 0.45	0.019- 0.28 0.22/ 0.77	0.01- 0.598 0.03/ 3.98		0.35 0.01/ 2.2	
Fish. Mean Min/max		0.189 <0.01/ 2.12	0.052 0.011 /0.20			0.173 <0.001/5.8						0.323 0.01/ 1.66		0.016- 0.129 0.001/ 0.49
Bivalves, Cephalopods Mean Min/max	0.5			0.024 <0.001/ 0.325		0.029 <0.001/0.66						0.0795 0.01/ 0.19		
Crustaceans Mean Min/max	0.5	0.065 <0.01/ 0.159		0.041 0.030/ 0.065										

*IR. One sample of butterfish: 1.05 mg/kg. **IR. One sample of smoked fish: 1.26 mg/kg

5.6 Comments on the mean adult population intake of total mercury by Member State:

This section only reports the mean intake of the adult population. Particular findings of interest are highlighted. Consumers, high-risk groups or particular age-segments are not included. A brief comment of the result from each Member State is given. Tables 5.7 – 5.26 provides additional information.

BELGIUM

Estimated intake of mercury: data for 3 food categories; the most important is fish (17.69 µg – 5.90% PTWI). The sum of the mercury intakes of food categories is 19.4µg/week, corresponding to the 6.47 % of the PTWI. The intake is based on the occurrence of mercury in dairy products, fish and crustaceans. The sum of these food groups intake is 2.78µg/day. Fish represents 91% of this value.

Analytical Quality Assurance

Certified reference materials have been used extensively as well as participation in proficiency tests. The results showed good correlation between found and certified results.

DENMARK

Estimated intake of mercury: data for 8 food categories. The most important are fish (6.72µg –1.87 % PTWI), beverages (5.11 µg – 1.42%PTWI), fruits and vegetables (4.27µg –1.19 %PTWI), cereals and bakery wares (4.06µg –1.13% PTWI). The sum of the mercury intakes of food categories is 24.5 µg/week, corresponding to 6.81 % of the PTWI. The intake is based on the occurrence of mercury in milk, cheese, fats, vegetables, fruits, confectionary, cereals and bread, meat and meat products, fish, eggs and beverages. Total dietary mercury intake was 3.5 µg/day. Fish, beverages and cereals/ bread represent of the total intake about 55%.

Analytical Quality Assurance

Certified reference materials were analysed in parallel to the samples

FINLAND

Estimated intake of mercury: Mercury intake for fish is 43.4µg/week of mercury, corresponding to 12.06 % of the PTWI. The intake is based on the occurrence of mercury in several fish species. The sum of these fish species was 6.2 µg/day. The highest contribution to is provided by pike (30.4%).

Analytical Quality Assurance

Certified reference materials and proficiency tests were used but not reported.

FRANCE

Estimated intake of mercury: data for 6 food categories. The most important are: fruits&vegetables (24.45 µg/week – 7.36% PTWI), fish (19.12 µg/week –5.76% PTWI).cereals excluding bakery wares (8.15 µg/week – 2.46% PTWI), Salt and spices(3.44 µg/week –1.04% PTWI). The sum of the mercury intakes of food categories is 59.34 µg/week, corresponding to 17.88 % of the PTWI. The intake is based on the occurrence of mercury in fruits and vegetables, mushrooms, cereals and cereal products, fish and fish products, molluscs and cephalopodes, crustaceans, salts, spices, sauces, water, soft beverages and alcoholic beverages. The sum of these food groups intake was 8.48 µg/day. The highest contribution to this value is provided by fruits and vegetables (26.2%), fish and fish products (18.9% + 13.3 % for 3.3.1.1.of regulation 466/2001 + 0.67 % for Molluscs and cephalopods + 1.11% for Crustaceans and echinoderm = 34 % for all the fish and fish products) and mushrooms (15%).

Analytical Quality Assurance

Certified reference materials have been used extensively as well as participation in proficiency tests. The results showed a good correlation between found and certified results.

GERMANY

Estimated intake of mercury: data for 11 food categories. The most important are: fruits&vegetables (22.86 µg - 6.48% PTWI), fish (19.6 µg –5.56% PTWI). Cereals and bakery wares (9.21 µg – 2.62% PTWI), meat and offal 11.34µg –3.22% PTWI). The sum of the mercury intakes of

food categories is 69.37 µg/week, corresponding to 18.68% of the PTWI. The intake is based on the occurrence of mercury in cheese, eggs, meat, fish, bivalves, crustaceans, cereals, nut and seeds, fruit and vegetables, dried fruit and vegetables, mushrooms, wine, honey, herbs and spices, sweeteners, game, liver and kidney, concentrated tomato, milk powder, oil, sugar, salt, water. The sum of these food groups intake was 9.91 µg/day. The highest contribution to this value is provided by vegetables, including fungi (33%).

Analytical Quality Assurance

Certified reference materials have been used extensively as well as participation in proficiency tests. The results showed a good correlation between found and certified results.

GREECE

Estimated intake of mercury: data for 2 food categories: fish (31.57 µg –9.02% PTWI), bivalve + crustaceans + cephalopoda (4.62 µg –1.32% PTWI). The sum of the mercury intakes of food categories is 36.19 µg/week, corresponding to 10.34 % of the PTWI. The intake is based on the occurrence of mercury in fish, molluscs and crustaceans. The sum of this food groups intake was 5.17 µg/day. Fish of Reg. 466/01 is about the 50% of the sum.

Analytical Quality Assurance

Laboratories have participated in proficiency tests programs; results regarding use of certified reference materials are reported

IRELAND

Estimated intake of mercury: data for 3 food categories. The most important is fish (6.44 µg – 1.72% PTWI) The sum of mercury intake of food categories is 9.59 µg/week, corresponding to 2.56 % of the PTWI. The intake estimated on the basis of the occurrence of mercury is 1.37 µg/day in fish, molluscs, crustaceans, meat and offals. Fish represents 67.2% of this value.

Analytical Quality Assurance

Laboratories have participated in proficiency tests programs; results regarding use of certified reference materials are reported.

ITALY

Estimated intake of mercury: only data for fish: (60.2 µg/week of mercury,), corresponding to 17.2 % of the PTWI. The intake is based on the occurrence of mercury in fish and molluscs. The sum of this food groups intake was 8.6 µg/day. Fish of Reg. 466/01 represents 58% of this value.

Analytical Quality Assurance

Certified reference materials have been used as well as participation in proficiency tests. No data regarding correlation between found and certified results are reported.

the NETHERLANDS

Estimated intake of mercury: data for 5 food categories. The most important is: fruits&vegetables (7.35 µg –2.23 %PTWI), The sum of the mercury intakes of food categories is 12.6 µg/week, corresponding to 3.8 % of the PTWI. The intake is based on the occurrence of mercury in fruits, vegetables, nuts, cereals, bakery wares, fish and fish products, salt, spices, soups, sauces and composite foods. The sum of this food groups intake was 1.79 µg/day. Fruits, vegetables and nuts represent about the 60% of the sum.

Analytical Quality Assurance

Certified reference materials were analyzed in parallel to the samples, as well as participation in proficiency tests. No data regarding correlation between found and certified results are reported.

NORWAY

Estimated intake of mercury: data for 2 food categories: fish (23.4µg –6.3% PTWI), bivalve+crustaceans+cephalopoda (5.04µg –1.38% PTWI). The sum of mercury intake of food categories is 28.4µg/week corresponding to 7.79 % of the PTWI. The intake is based on the occurrence of mercury in several fish species. The sum of these fish species intake was 4.06 µg/day. Lake trout represents 20.5% of this value.

Analytical Quality Assurance

Certified reference materials have been used as well as participation in proficiency tests. No data regarding correlation between found and certified results are reported.

PORTUGAL

Estimated intake of mercury: data for 4 food categories. The most important are fish (91.7µg –26.2 % PTWI), bivalve +crustaceans+cephalopoda (5.6 µg –1.6% PTWI). The sum of mercury intake of food categories is 100.66 µg/week, corresponding to 28.76 % of the PTWI. The intake is based on the occurrence of mercury in liver, sugar, fresh fish and molluscs. The sum of this food groups intake was 14.38 µg/day. Fresh fish represent 91.6%.

Analytical Quality Assurance

Certified reference materials have been used as well participation in proficiency tests. Methods validated.

SWEDEN

Estimated intake of mercury: only data for fish: (18.9µg/week of mercury), corresponding to 5.13 % of the PTWI. The intake is based on the occurrence of mercury in several fish species. The sum of these fish species intake was 2.7 µg/day. The highest contribution to this value is provided by cod type fish represent 22.6% of the sum.

Analytical Quality Assurance

Certified reference materials have been used extensively as well as participation in proficiency tests. The results showed a good correlation between found and certified results.

UNITED KINGDOM

Estimated intake of mercury: data for 10 food categories. The most important categories are: fish (7 µg), cereals and bakery wares (4.34 µg). The sum of the mercury intakes of food categories is 21.14 µg/week. The intake is based on total diet study. Total population intake was 3.02 µg/day. The highest contribution to the intake is provided by fish (33%).

Analytical Quality Assurance

Certified reference materials have been used extensively as well as participation in proficiency test. The results showed a good correlation between found and certified results.