1. How does mercury affect our health?

Introduction

The Spanish have known for 2,000 years that slaves in the mercury mines gradually got sick and died. In the 1960s and '70s, acute and widespread poisonings such as those in Minamata, Japan, made mercury notorious as a nervous system toxicant and as a cause of birth defects. More recently, studies in the Faroe Islands and elsewhere have shown that low doses of mercury in mothers during pregnancy can have a negative impact on the development of their child's brain.

Ongoing scientific research gives us a more sophisticated understanding of the toxicity of mercury and its complex health effects. This is reflected by the fact that the 'safe' levels are regularly reduced. Alongside the substantial evidence and concern about effects on neurological development, other recent studies show that low doses of mercury can also have other health impacts, such as effects on the cardiovascular system. The health effects of small doses of mercury may not be apparent in individual children, but at the level of the wider population they have far more significance, with reduced numbers of 'gifted' children and greater numbers with low IQ scores.

The emerging scientific recognition about the destructive impacts of low doses raises urgent questions about the health risks that have already been and are currently being incurred under the existing safety levels. Given the downward trend of safety levels, precautionary public policy requires that we anticipate the need to build in further safety margins. At the same time, the need to address the source of the mercury problem is therefore becoming more pressing.

What is mercury?

Mercury has no positive role in the human body[1]; in fact a safe level of mercury exposure is very difficult to determine. It can be present in the environment in several different forms, and while all forms of mercury are toxic to humans, the pattern of toxicity varies with its chemical form, the route of exposure, the amount, the duration and timing of exposure[2], and the vulnerability of the person exposed[3].

For example, pure elemental mercury (also known as quicksilver or Hg) is liquid at room temperature. If ingested, quicksilver has very low toxicity because it is not absorbed by the gastrointestinal tract and is eliminated completely in the stool. If quicksilver is agitated or heated, however, the liquid mercury becomes a vapour which is readily absorbed by inhalation and is highly toxic to the lungs and central nervous system. The nervous system is the primary target of mercury toxicity, but, depending upon the specific exposure, the kidneys, liver and lungs are also important targets. Table 1 (Page 21) gives an overview of the different forms of mercury, their uses, routes of exposure and their toxicity.

The two biggest sources of exposure to mercury for the general population are through our consumption of fish, and associated with medical and dental practices.[a] People in developed countries have significant exposure from the mercury in their dental fillings[4]. However, our environmental exposure to methyl mercury, a highly toxic form of organic mercury found in ocean and freshwater fish and marine mammals, is a cause of great concern. The impact on public health as a result of exposure to methyl mercury is therefore the major emphasis of this chapter.

Human health effects of mercury

High doses of mercury can be fatal to humans, but even relatively low doses of mercury containing compounds can have serious adverse impacts on the developing nervous system, and have recently been linked with possible harmful effects on the cardiovascular, immune and reproductive systems[5].

Mercury and its compounds affect the central nervous system, kidneys, and liver and can disturb immune processes; cause tremors, impaired vision and hearing, paralysis, insomnia and emotional instability. During pregnancy, mercury compounds cross the placental barrier and can interfere with the development of the foetus, and cause attention deficit and developmental delays during childhood[6].

The effects of low dose mercury exposure are discussed in more detail on Pages 10-12.

---

[a] Medical exposures occur when mercury containing preservatives like thimerosal are used in certain vaccines and pharmaceutical agents. Exposure to mercury vapour can occur during placement and removal of mercury containing dental amalgams, as well as during normal chewing when mercury amalgams are present. Please read our fact sheet series on Mercury and Health for more details.

HEALTH EFFECTS OF MERCURY AT A GLANCE

Nervous system –
developmental delays, impaired vision and hearing, motor function, brain function, IQ

Cardiovascular system –
High blood pressure, altered heart rate, increase heart attack risk

Effects on the immune and reproductive systems, liver and kidneys

History of poisonings

The effects of acute exposure to mercury, as a result of accidental contact with high amounts of mercury following isolated incidents, are well documented and understood. The best known of these incidents were in Japan and Iraq (see box).

Individuals exposed to mercury spills in the workplace, home or school may be exposed to dangerous or even fatal levels of mercury.

MINAMATA DISEASE

Methylmercury poisoning was first recognised in Minamata, Japan around 1960[7]. Hundreds of fishermen and their families were severely poisoned during the 1950s by methyl mercury that bioaccumulated in fish as a result of the release of mercury to the bay from a local chemical plant. Many severe effects were observed including parasthesia (abnormal physical sensations such as numbness), gait disturbances, sensory disturbances, tremors, hearing impairment and many mortalities[8]. By 1960 the serious and mysterious affliction, affecting both adults and infants, was recognised as methyl mercury poisoning, a hitherto unrecognised disease. High level exposure produced serious neurological disease in adults, but the most dramatic manifestation was congenital Minamata disease in infants born to mothers with high mercury levels. These babies were born with severe cerebral palsy, blindness and profound mental retardation[9]. Some severely affected children were born to mothers who themselves showed no evidence of mercury-related impacts.

Iraq. Epidemics of organic mercury poisoning from consumption of grain treated with organomercurial fungicides have also occurred in Iraq and Guatemala. In Iraq, children exposed during foetal development were severely affected, consistent with the Minamata findings[10]. By the time the severe Iraq outbreak occurred in 1971, epidemiologists and toxicologists were alert and analytical results (mainly hair mercury) were obtained and used in risk assessment. This resulted in calculation by the US National Research Council of an intake ‘reference dose’ of 0.3 ug/kg/day for adults, recently revised to 0.1 ug/kg/day, sufficient to protect the neurobehavioural development of the foetus[11].

“Mercury has long been recognised as a major source of toxicity in children causing reduced cognitive functioning, including reduced I.Q. However, we are now seeing that even ‘low’ exposure levels can cause damage to the developing brain of the foetus and infant. These are mercury levels that are not known to cause acute poisoning or ill health in adults. We also know that mercury is ‘stored up’ in women even before pregnancy. Therefore, preventing exposure to future children means reducing everyday exposure today.”

Hg

Gavin ten Tusscher, M.D., Ph.D., paediatrician, Department of Paediatrics and Neonatology, Westfries Gasthuis, Hoorn, the Netherlands

Levels of mercury and biomonitoring

Levels of pollutants in people's bodies can be estimated through biological monitoring, or biomonitoring. Scientists can analyse samples of urine, serum, saliva, blood, breast milk and other tissues (such as hair, body fat and teeth) to measure the levels of various chemicals in the body. The most common way of measuring mercury is in hair, blood and urine.

Biomonitoring can show whether and how much an individual or a population has been exposed to a chemical. However, because some people are more sensitive than others, it is hard to predict how much someone will be affected by a given concentration of mercury in their bodies.

Exposure to methyl mercury can also be estimated at the population level by measuring the amount found in a sample of fish species and calculating exposure from average consumption patterns. However, this will not protect people whose fish consumption differs significantly from the average.

TABLE 1. Comparison of methyl mercury limits

		levels corresponding to the intake dose	
	INTAKE DOSE	HAIR	BLOOD
FAO/WHO Joint Expert Committee on Food Additives (JECFA)	1.6 µg/kg body weight Provisional Tolerable Weekly Intake (PTWI)[i]	14 mg/kg[ii] *2 µg/ gram corresponds approximately to the PTWI*	
US EPA reference dose US National Research Council (NRC)	0.1 µg/kg body weight per day.[iii] OR 0.7 µg/kg body weight per week	*1 µg/ gram of hair*[iv]	*5.8 µg/L*[v]

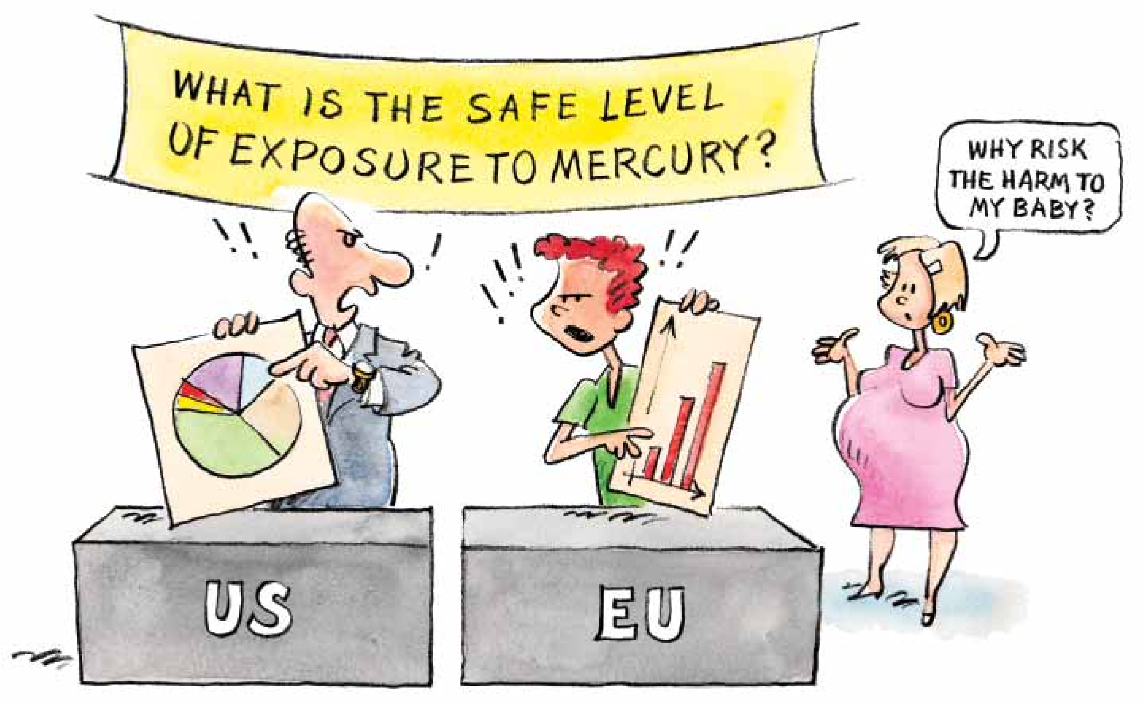
i FAO/WHO Joint Expert Committee on Food Additives (JECFA), Summary & Conclusions. 61st Meeting, Rome, 10-19 June 2003. See www.chem.unep.ch/mercury/Report/JECFA-PTWI.htm

ii Taking the average from the two studies in the **Seychelles and Faroe Islands**, the committee established this level in maternal hair reflecting exposures that would be without appreciable adverse effects in the offspring in these two study populations.

iii United States Environmental Protection Agency (1997) Mercury Study Report to Congress, Volume VII: Characterization of Human Health and Wildlife Risks from Mercury Exposure in the United States. p. 19 http://www.epa.gov/ttn/oarpg/t3/reports/volume7.pdf accessed 8 November 2006

iv United States Environmental Protection Agency (1997a), Mercury Study Report to Congress Volume IV: An Assessment of Exposure to Mercury in the United States. http://www.epa.gov/ttn/oarpg/t3/reports/volume4.pdf

v United States Environmental Protection Agency (1997a), op.cit.



Setting a 'safe' level of mercury

In 1990, WHO concluded that a safe level of mercury exposure is very difficult to determine due to lack of information on a dose-response relationship between methyl-mercury exposures in mothers and the neurological effects on their offspring[12].

Nevertheless, various national, European and international authorities have established limits for intake of mercury. They have done this by identifying a 'Benchmark' dose: the lowest level at which adverse health effects, such as impacts on the developing brain functions of the foetus, are known to occur (the Lowest Observed Adverse Effect Level - LOAEL). The authorities then calculate a safety margin and set a tolerable intake dose or 'reference' dose just below this safety margin – a level at which there is not likely to be an impact.

The WHO concluded in 1990 that: 'A prudent interpretation of the Iraqi data implies that a 5% risk may be associated with a peak mercury level of 10-20 µg/g in maternal hair"[13], and subsequently calculated a [benchmark dose] limit of 10 µg/g in hair[14].

Since then, lower intake limits have been set by the Joint Expert Committee of the WHO and the FAO (JECFA); and the US National Research Council. These limits are those most commonly referred to. Both have set advisable doses for weekly intake and the levels in hair which correspond to these doses have then been determined. So, for example the WHO/JECFA has set a Provisional Tolerable Weekly Intake (PTWI) of 1.6 µg/kg body weight, which corresponds to a level in hair of 2 µg/gram[15].

A lower intake 'Reference Dose' has been established by the US National Research Council (NRC), for methyl-mercury of 0.7 µg/kg body weight per week, which the US EPA calculated would correspond to a level in hair of 1 µg/gram[16]. The NRC used a greater safety margin from the 'Benchmark Dose Limit' to calculate their intake 'reference' dose.

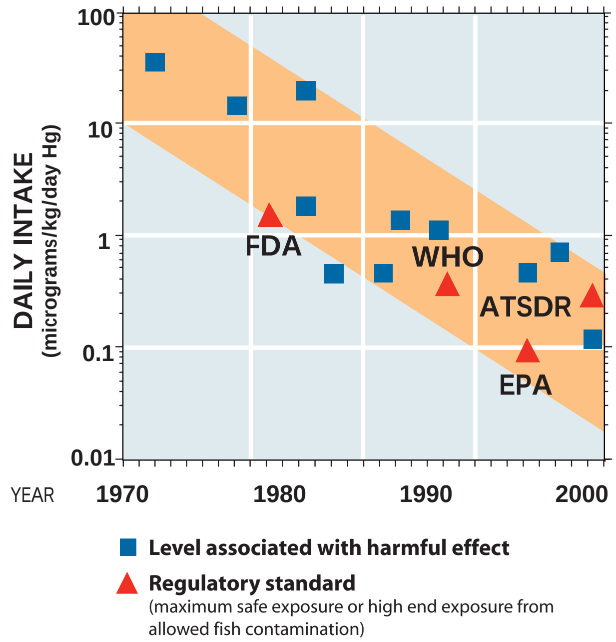
While these differences may not seem significant, in light of the continuing downward trend for safety levels, in this case, the US level has the advantage of being more precautionary or protective of public health. The US reference dose is the one which the European Commission refers to in its Extended Impact Assessment[17]. It is also the limit we refer to in this report.

> *"The evidence that a mother's exposure to methyl mercury can affect the neurodevelopment of her unborn child is not disputed. What is still debated is the level of environmental mercury contamination which causes documented harm. Over time, our techniques have improved and we have been able to identify harm to humans at lower and lower levels. In time, it is likely that the scientific consensus will conclude that there is no safe level of foetal exposure."*
>
> Hg Peter Orris, MD, MPH, FACP, FACOEM, Professor at University of Illinois at Chicago School of Public Health

As knowledge about the health effects from low levels of mercury exposure has increased over the years, there is a trend for the 'safe' limits set by regulatory authorities to get progressively lower, as shown in Figure 1[18].

FIGURE 1.
Declining threshold of safety from harm

This graph displays the apparent toxic threshold for mercury as it was identified at various points in time over the past three decades. It illustrates the tendency for apparent toxic thresholds to decline with advancing knowledge.



The estimates of dose–response relationships at low exposure levels are subject to considerable uncertainty but all prenatal effects to date have been found to be neurologically irreversible[19].

Most vulnerable populations – most vulnerable, most exposed

The full extent of exposure to mercury in children and adults in Europe or globally is still unknown. A recent EU assessment[20] suggested that as many as one in 20 people may be affected. The study estimates that between 1-5% of the general population in Central and Northern Europe (3 to 15 million people), and people in coastal areas of Mediterranean countries have levels that are around the US NRC reference dose. Even more worrying is the fact that a percentage of this population, notably Mediterranean fishing communities and the Arctic population, have levels ten times as high as the recommended norm - that is, benchmark levels where definite adverse impacts to babies can be expected. Children and foetuses appear to be more affected than the population as a whole. For example, the EU assessment estimates that 44% of 3-6 year old children in France may have mercury levels above the US NRC reference dose.

"One of the priorities of the Children's Environment and Health Action Plan for Europe, CEHAPE, adopted by WHO Member States across Europe, is specifically to reduce children's chemical exposures: the global effort working towards eliminating mercury is part of that. There is a growing understanding of the terrible damage that mercury does to the health of children and future generations."

Dr Roberto Bertollini, WHO Regional Office for Europe

The US National Academy of Sciences identified that 'the population at highest risk is the children of women who consumed large amounts of fish and seafood during pregnancy'[21]. Infants and young children are also susceptible to damage from methyl mercury exposure. This is because the human brain and body develops at a dramatic rate *in utero* and during the first few years of life. In addition, infants and young children may have higher exposures, because they consume more food in relation to their body weight than older children and adults[22].

Illustrative mercury sampling survey – 250 women

As part of our campaign to raise awareness about our exposure to mercury and its dangers to our health, Health and Environment Alliance and Health Care Without Harm Europe commissioned chemical analysis of hair samples to assess the levels of mercury in volunteer women of childbearing age. The combined results of testing in many different countries provide a unique, small scale survey on exposure of women of childbearing age to mercury across a number of countries. This study is an illustrative survey; it is not based on the wider population and was not designed to make predictions about it. The purpose is to help provide a snapshot that can be used to raise awareness, particularly among women, who can take personal precautions (see box on fish consumption, Page 16) to reduce exposure in the most vulnerable group – their unborn children. It also gives an indication of some of the problems that might be uncovered by the planned European Union biomonitoring (see Page 31). Non-EU governments should also follow their lead.

"As one of the national coordinators in this project, I learnt how worried many women are about exposure to mercury. Some were worried about what fish to eat, others about their dental fillings or exposure at work. They felt they did not have enough information. We were overwhelmed by the number of women wanting to participate in this survey. Women have the right to be informed so that they can protect themselves and prevent any effects on the foetus during pregnancy."

Sascha Gabizon, national coordinator in Germany and international director of Women in Europe for a Common Future (WECF), the Netherlands

Why hair sampling?

Hair sampling was chosen because it is not an invasive technique and provides information about exposure to mercury over time, making it preferable to blood analysis. Depending upon the length of the hair sample, it is possible to ascertain exposure to mercury over several months. Mercury is incorporated into hair as it grows and remains in hair for a long time. The level of mercury in human hair can provide valuable information about exposure to mercury in the diet. Women were involved in this sampling exercise as the developing foetus is more sensitive to mercury pollution than adults or even children; and can suffer irreversible brain damage at even low exposure levels. A woman's body can store mercury before pregnancy which is later bioconcentrated across the placenta to the foetus. Also, a woman exposed to methylmercury during pregnancy will pass it on to her developing child and to a much lesser extent, through breast milk once the child is born. It should nevertheless be noted that breastfeeding is beneficial to the growing child and the amount of mercury in breast milk is not a problem under normal circumstances. The WHO advises all women to continue to breastfeed for six months and continue breastfeeding along with adequate complementary feeding for 2 years or more.

Results and interpretation

We received over 260 samples from 21 different countries, most of them within Europe (EU and non-EU countries), plus South Africa, the Philippines, India and Argentina. Both hair samples and completed questionnaires were sent to the Provincial Institute of Hygiene and Bacteriology of the Hainaut, Belgium, for laboratory analysis and interpretation. Quality control and quality assurance procedures are outlined in the testing protocol in Annex 1. The results are consistent with results found in the scientific literature, and show the distribution illustrated in Figure 2.

"Women, particularly those who may become pregnant or are pregnant, don't have enough information on what they need to know about mercury in their body and how to protect themselves and their babies. As a leader of a breastfeeding support group I participated in the "Stay Healthy, Stop Mercury" campaign to find out more and share this with others. In my work I often meet mothers who are breastfeeding young babies who are concerned about this issue."

Erin Meyer is a La Leche League leader in Belgium

91% of volunteers submitting samples were women between 18 and 45 years old[b] These women were concerned with the issue in some way; as members of health, environment or women's organisations, as doctors, nurses, dentists or other health-related positions, or in positions of leadership, such as MPs.

All testing samples were cut individually or by a national coordinator (a member of collaborating NGO), placed in the small plastic bag provided and sent by courier to HEAL, where they were given reference numbers. Strict ethical and confidentiality rules were followed. The laboratory collected the samples anonymously and an informed consent was obtained from all volunteers.

The exposure values ranged from not detectable to 4.96 µg/g or ppm (parts per million) of total mercury in hair.[c] 95% of volunteers had detectable levels of mercury in their hair[d]. The lowest detectable level in the hair samples was 0.05 µg/g.

[b] Out of 266 samples, 23 did not fall into the criteria defined in the protocol, ie women between the ages of 18-45.

[c] The lab measured the total level of mercury in hair including organic and inorganic mercury. See the Testing Protocol in Annex 1

[d] Out of the 243 volunteers of child bearing age, 232 had detectable levels.

> *"I wanted to take part in the hair sample testing because I work in a chemical lab where we handle mercury. I have been worried for a long time that this contact may not be good for my health."*
>
> Maria Toneva works in a chemical lab in Bulgaria

As illustrated in Figure 2, all of the 266 participants tested were below the WHO benchmark value, 10 µg/g in hair[23], adopted in 1990. The US National Research Council has set the most protective limit, or 'reference dose', of 0.7 µg/kg body weight per week, which the US EPA calculated would correspond to a level in hair of 1 µg/gram (see Page 10, Setting a 'safe' level of mercury). In our survey, 42 hair samples (16 %) had results above 1 µg/gram. The mean mercury hair level was 0.53 µg /gram.

FIGURE 2. Mercury levels in survey of hair samples

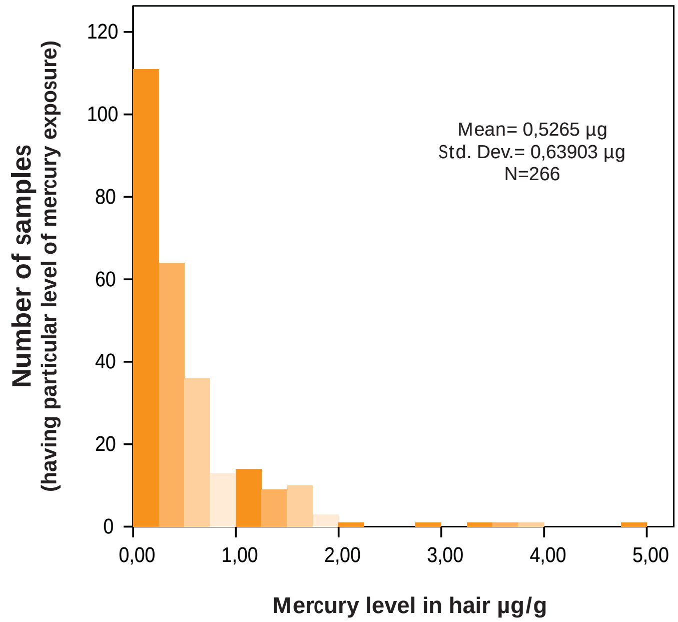
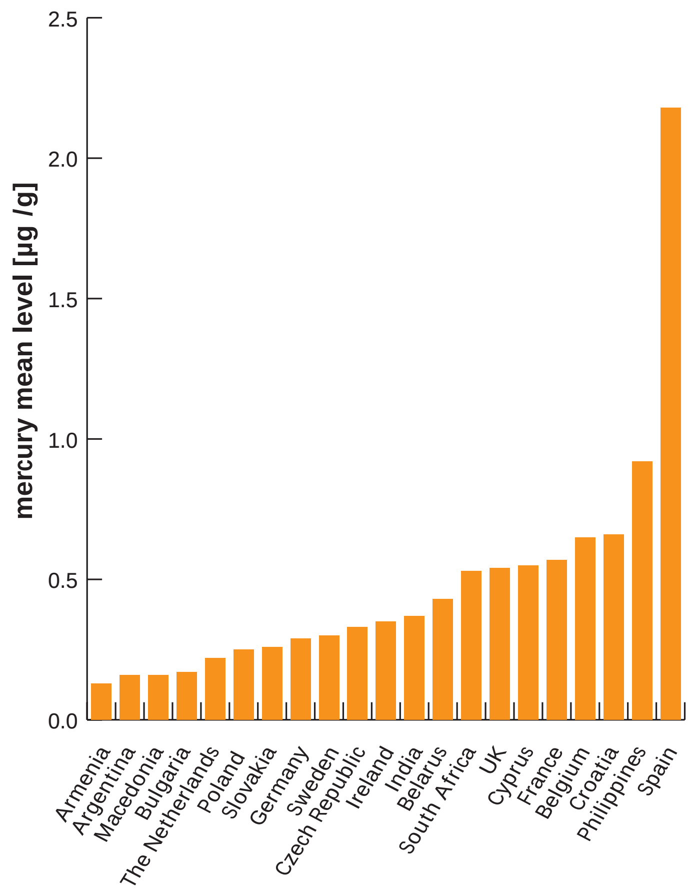


FIGURE 3. Mean values of mercury in hair samples



See Annex 2 for figures on mean values of Hg in hair per country.

For the interpretation of the data, 252 samples were used for a statistical analysis of the results in relation to the country of origin, including 9 samples from Spain that showed comparatively high levels of mercury exposure (mean levels were 2.18 µg/g for Spanish samples).

> *"The results of the samples taken from Czech women did not show high levels of mercury. This is probably because the country is landlocked and fish consumption is low. However, this does not mean that the Czech government should not take a responsible attitude and play its part in EU efforts to stop this pollution. Mercury pollution is a global problem and we must tackle it with global instruments and policies."*
>
> Jana Hybaskova MEP, European People's Party (EPP), Czech Republic

Elevated levels in Spain

Increased values in Spanish volunteers are consistent with conclusions of the EU Mercury Extended Impact Assessment that states: "most people in coastal areas of Mediterranean countries… are around the Reference Dose (RfD)" which corresponds to 1 µg /g of mercury in maternal hair. This is a dose below which there is not likely to be a neurological impact on their children. The European Commission further notes that some Mediterranean and Arctic communities who frequently consume lots of fish have mercury levels in hair above the National Research Council (NRC) US "Benchmark Dose Limit" (BMDL); the equivalent figure for hair is 10 µg/g. This is the level at which there is a significant detectable impact on brain function in the developing foetus.[24]

More specifically, several studies of communities consuming large amounts of fish have found elevated levels of mercury. For example, concentrations of mercury in maternal hair in Madeira, Portugal ranged from 1.1 to 54.4 µg/g, with a median of 9.64 µg/g[25]. Median hair mercury concentrations 9.6 µg/g have also been measured among a sample of 8 regular consumers of large tuna in Sardinia[26]. The levels of mercury in the Spanish hair samples were lower than the Benchmark Dose Limit (the highest sample was 5 µg /g) but indicate elevated levels which might be due to higher fish consumption.

There could also be other sources of mercury exposure. The most recent study from Spain found that children living near a chlor-alkali plant had median mercury values in the hair nearly twice as high as children living on Menorca Island (0.631 µg/g vs. 0.370 µg/g).[27]

More research would be needed to discover the reason why the levels in the Spanish women in our survey were so much higher than those from other countries. Two possible causes are: the amount and contamination of fish in their diets and possible exposure at work, since all the women work in the same hospital where they come into contact with mercury.

In the case of occupational exposure, i.e. inhalation of mercury vapours, the hair might be externally contaminated. Our analysis did not distinguish between methyl mercury contamination and other types of mercury in hair.

Trends in the survey

There were limitations to the study due to the size of the survey and self-identification of the volunteers. In individual countries the sample size varied and selection was not representative at all regarding region, age or other population characteristics. However, despite these limitations, the following trends were observed.

The link with fish

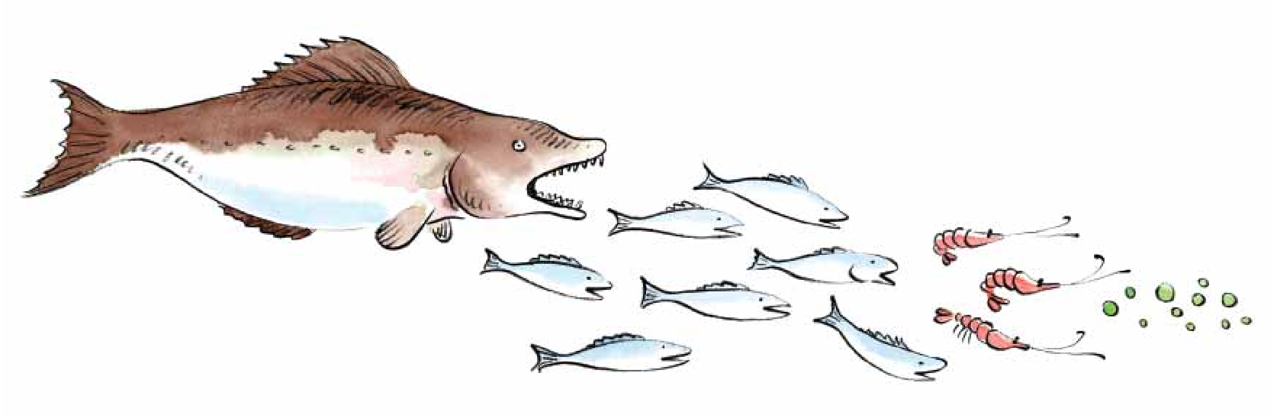
In the more detailed examination, we found that women who regularly eat various kinds of fish tend to have higher levels of mercury levels in hair. Those women who eat various types of locally purchased and commercially traded fish more frequently showed increased mercury exposure.

This finding is consistent with the many scientific studies in the literature. In Germany, the Robert Koch Institute measured mercury levels in adults' blood. They found significant increases in mercury levels related to more frequent fish consumption.[28]

The mean mercury hair levels in our survey for Swedish participants were 0.3 µg/g. A scientific study from 2003 found mercury levels in hair of pregnant Swedish women ranging from 0.07-1.5 µg/g with mean of 0.35 µg/g. Again, the authors reported increased mercury hair levels for women who consumed seafood and fish more frequently[29].

Similar conclusions from a recent US study are also consistent with our findings. The mean maternal hair mercury levels in a U.S. cohort were 0.55 µg/g, in the range of 0.02–2.38 µg/g[30].

Finally, in the Czech Republic, the State Health Institute biomonitors blood mercury levels in adults and reports slightly increased mercury blood levels for women in 2004 and 2005. Children's hair is also examined to monitor levels of heavy metals, and mercury levels are comparable with those we found in our survey; the highest values were reported in 2003 with a maximum of 1.98 µg/g of mercury in hair. Czech women from our survey show mean levels 0.33 µg/g, while the highest level of mercury exposure was 1.58 µg/g[31].



Methylmercury bioaccumulates in larger predatory fish, which contain much higher levels than non-predatory fish

Fish consumption

Eating contaminated fish is the major source of human exposure to methylmercury. The populations most sensitive to the compound are foetuses, infants, and young children. Consequently, fish consumption by pregnant women, young children and women of childbearing age is a particular cause for concern because of the likelihood of mercury exposure. Methylmercury bioaccumulates in larger predatory fish, which contain much higher levels than non-predatory fish[32].

EUROPEAN RECOMMENDATIONS

The European Food Safety Authority (EFSA) recommends that "women of childbearing age (in particular, those intending to become pregnant), pregnant and breastfeeding women as well as young children select fish from a wide range of species, without giving undue preference to large predatory fish such as swordfish and tuna".[33]

Following this recommendation, the European Commission released an "Information Note" based on the need to give more specific advice to vulnerable groups and to provide them with concrete information[e]. It suggests that women who might become pregnant, women who are pregnant or are breastfeeding and young children should not eat more than one small portion (less than 100 g) per week of large predatory fish, such as swordfish, shark, marlin and pike. If they do eat a portion of this fish, they should not eat any other fish during the same week. Nor should they eat tuna more than twice per week[34].

The EU member states vary widely in their recommendations on fish consumption. Some have no recommendations for vulnerable groups whereas other countries have recommendations that are stricter than those of the European Food Safety Authority (EFSA) above, most notably Sweden.

It is important to consider that fish is an excellent source of essential nutrition. Smaller fish, which are lower in the food chain and therefore accumulate less mercury, are also excellent sources of protein and provide omega 3 fatty acids that are important to neurodevelopment, cardiac function and good health. In contrast, just one serving of fish that is high in mercury may fill an advised mercury quota for several days or even weeks.

For details of national recommendations relating to different species of fish and further advice on fish consumption, see: *HCWH/HEAL Fact sheet on Mercury and Fish Consumption.*

[e] The Commission made a rough calculation, based upon levels of methylmercury in fish compared with the "Provisional Tolerable Weekly Intake" (PTWI) established by the Joint FAO/WHO Expert Committee on Food Additives, to make recommendations more tangible to the public. The PTWI is a tolerable intake based on a weekly level, to emphasize that long-term exposure is important because contaminants accumulate in the body. Joint FAO/WHO Expert Committee on Food Additives. (2003) Summary & Conclusions. 61st Meeting, Rome, 10-19 June 2003. See: www.chem.unep.ch/mercury/Report/JECFA-PTWI.htm

Link with occupation

This survey was too small to detect any link between professional contact with mercury (for example via mercury containing products used by nurses or dentists) and the levels of mercury in hair. However, it remains a possibility that workers in the healthcare sector need to be aware of.

A number of the volunteers for this survey came from the healthcare sector and reported that they are in daily contact with mercury, which can lead to increased mercury exposure. Some of the volunteers lived or worked at industrial complexes where mercury emissions are reported. Other sources of exposure are living or working close to industrial sources of mercury emissions such as coal burning power stations, chlor-alkali plants using mercury cell technology or, in countries outside of Europe, living in small-scale gold mining communities.

> *“Health professionals in some countries of Asia, including India, are phasing out mercury in hospitals. My organisation has helped encourage these initiatives and five hospitals in New Delhi have switched over to digital products. Our message to the EU is that it should stop all exports of mercury. We would like to see Europe playing a leadership role in efforts to achieve a global ban.”*
>
> Hg Ratna Singh was national coordinator to the participants in the hair sample testing and survey in India. She works with Toxics Link, which is a member of Health Care Without Harm

> *“I eat a lot of fish and was surprised and concerned to learn that this might present a risk during pregnancy. I think my government should be providing more information about mercury in fish.”*
>
> Hg Violeta Krstevska is a nurse in Macedonia

Conclusions from the mercury sampling survey

Our small snapshot survey has shown that mercury levels are being detected in the majority of women tested and that consumption of fish is linked to the level of mercury in hair. These findings are comparable to numerous studies and other human biomonitoring projects that have been carried out in Europe and the United States. The fact that mercury was found in almost all of the samples and that low doses can matter highlights the need for an immediate action from policy makers to reduce our exposure to mercury.

The concerns raised in this survey also need further investigation through detailed biomonitoring at a wider population level with a specific focus on regions where higher exposure has been identified and sites of possible workplace exposure.

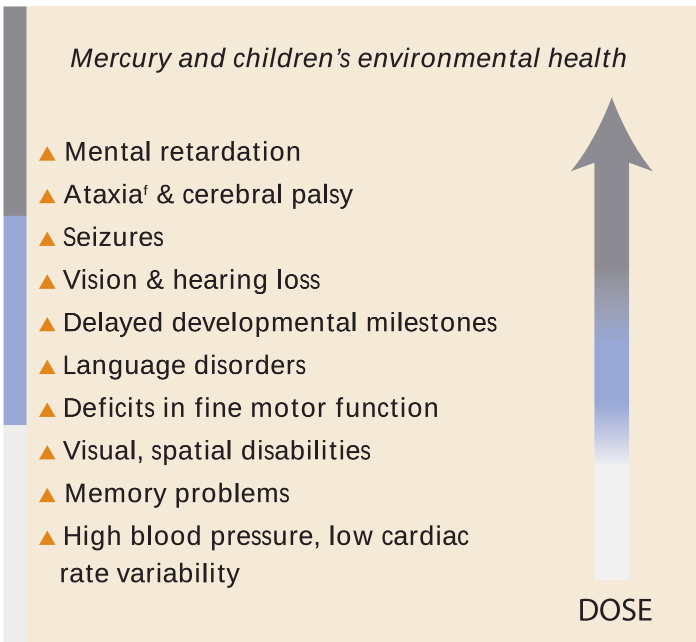
Why we should be concerned about low dose mercury exposure

There is extensive evidence of effects on the development of the brain from high dose poisoning episodes such as those in Japan and Iraq. Ongoing, or chronic, exposure to low levels of mercury in the environment is less well understood than acute toxicity. It is now one of the most critical areas of mercury health research, since many people are exposed to methyl mercury levels at low levels, not high enough to cause obvious signs of poisoning[35].

Effects on the developing foetus

Foetuses and young children are actively developing and therefore most at risk from health effects including neurological damage, resulting in behavioural problems and learning disabilities[36].

FIGURE 4. Effects of prenatal exposure[37]



[f] Ataxia is unsteadiness due to the brain's failure to regulate the body

Neurological effects: Low doses of methyl mercury in pregnant women have been shown to have impacts on the foetus[38]. In a major review of mercury health studies the US National Academy of Sciences stated:

'Chronic, low-dose prenatal methylmercury exposure from maternal consumption of fish has been associated with …poor performance on neurobehavioural tests, particularly on tests of attention, fine-motor function, language, visual-spatial abilities (e.g. drawing) and verbal memory.'

The review looks at three large epidemiological studies. Two of these, one in the Faroe Islands and one in New Zealand, found these associations; those effects were not seen in the other study, in the Seychelles Islands. In all the studies the methyl mercury exposure resulted from the mother's consumption of fish[39].

- In a study which assessed neurobehavioural effects in 878 children at ages 7 and 14 from the Faroe Islands, prenatal methyl mercury exposure was 'significantly associated with deficits in motor, attention and verbal tests'; post-natal exposure had no discernible effect. The study concluded that 'the effects on brain function associated with prenatal methyl mercury exposure therefore appear to be multi-focal and permanent'[40].

Cardiovascular effects: Two recent epidemiological studies found associations between exposure to low levels of methyl mercury and adverse cardiovascular effects[41]. The US National Academy of Sciences concludes that additional studies are needed to better characterise the effect of methyl mercury exposure on blood pressure and cardiovascular function at various stages of life. The European Commission also notes recent evidence suggesting that mercury from fish and seafood may promote or predispose the development of heart disease[42].

Effects at the wider population level

It is important to distinguish individual risk from population risk. Subtle neurological effects from low doses of mercury that may be too small to be clinically significant for the individual child might be quite important when the population as a whole is considered[43].

- A recent analysis of three epidemiological studies found that prenatal mercury exposure sufficient to increase the concentration of mercury in maternal hair at childbirth by 1 ug/g decreases IQ by 0.7 points[44].

- In a recent US study, levels of maternal hair mercury at delivery were correlated with 6-month infant cognition. Offspring of mothers with hair mercury above 1.2 µg/g had lower scores for cognition tests than those with hair mercury below 1.2 µg/g. Higher scores for cognition abilities appeared highest among infants of mothers with high fish intake and low mercury levels, whereas scores appeared lowest in infants of mothers with low fish intake and high mercury[45]. The authors recommend that 'women should continue to eat fish during pregnancy but choose varieties with lower mercury contamination'.

- Exposure to neurotoxic chemicals such as lead and methyl mercury could reduce the number of children with far above average intelligence (IQ scores above 130 points), and might likewise have increased the number with IQ scores below 70[46].

- For example, a study from 2005[47] states that between 316,588 and 637,233 children in the US have cord blood mercury levels greater than 5.8ug/l (although subsequent levels were not as high), a level reported to be associated with loss of IQ[48]; other neurodevelopmental effects may also occur at that level with similar implications. One way to measure the cost of methyl mercury toxicity is by lost productivity, which the study estimates at $8.7 billion annually (range $2.2 – 43.8 billion).

These seemingly small impacts on brain development can therefore have a profound effect at the level of the wider population.

The results of our survey on exposure of women of childbearing age show that women are carrying too much mercury. Other studies show that the population as a whole is exposed to mercury. Therefore the population at risk from sub-clinicial neurotoxicity from mercury could be very large.

The most recent data[49] suggest that the neurotoxic effects of methylmercury exposure may yet extend significantly below even the US 'safe' dose (RfD). In its Impact Assessment, the European Commission supports the possible benefits of decreasing exposures further, even for those who are below the present 'safe' levels;

- '*although effects at such levels would be likely to be less important than those occurring at higher exposures, this nevertheless suggests there may be benefits of decreasing exposures even for populations who are below the present RfD/PTWI levels[50].'*

The trend for health effects to become apparent at ever decreasing doses indicates that we need to anticipate potential problems, rather than react in retrospect; there is an urgent need for action, based on **'new, precautionary approaches that recognise the unique vulnerability of the developing brain'[51].**