

Dietary recommendations regarding pilot whale meat and blubber in the Faroe Islands

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For centuries the pilot whale has been an important part Faroese life – both in regard to food and culture. However, studies dating back to 1977 have shown an increase in contamination of the meat, blubber, liver and kidneys of pilot whales. Several birth cohorts have been established in the Faroes in order to discover the health effects related to mercury and organochlorine exposure. In short the results have so far shown that: mercury from pilot whale meat adversely affects the foetal development of the nervous system; the mercury effect is still detectable during adolescence; the mercury from the maternal diet affects the blood pressure of the children; the contaminants of the blubber adversely affect the immune system so that the children react more poorly to immunizations; contaminants in pilot whales appear to increase the risk of developing Parkinson's disease in those who often eat pilot whale; the risk of hypertension and arteriosclerosis of the carotid arteries is increased in adults who have an increased exposure to mercury; septuagenarians with type 2 diabetes or impaired fasting glycaemia tended to have higher PCB concentrations and higher past intake of traditional foods, especially during childhood and adolescence. Also impaired insulin secretion appears to constitute an important part of the type 2 diabetes pathogenesis associated with exposure to persistent lipophilic food contaminants. From the latest research results, the authors consider that the conclusion from a human health perspective must be to recommend that pilot whale is no longer used for human consumption.

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The Faroese have for centuries killed long-finned pilot whales (*Globicephala melas*), and the pilot whale has in many ways been an important part of Faroese life – both in regard to food and culture.

There are many accounts of the importance of the pilot whale for the Faroese people. If some years went by without any whales, it was reflected in the household, and the joy was great, when this gift from God again appeared from the sea. There is no doubt that this food source in many ways has contributed to good health and has remedied imminent hunger in many homes (1). As late as in the 1970s, school doctors would write on the note for the parents that they should make sure that blubber was included with the breakfast.

Mercury and PCB contamination

In 1977 the first examinations were carried out to document the contamination of the meat, blubber, liver and kidneys of pilot whales. These studies were initiated to ascertain if the mercury content in the pilot whale was

elevated, since this whale is high in the marine food chains, and since other studies had shown that the amount of mercury was increased in marine species via food chains, where the toothed whales belong to the highest level. And the results of these analyses were remarkable. They showed that the mercury concentration in the meat itself was high, and that it was further increased by about 100-fold in the liver and kidneys, as compared to the whale meat. This led to the first advise from the Chief Medical Officer of the Faroes to the general population to limit the consumption to only one main meal weekly and avoid liver and kidneys (2). Since 1980, pregnant women have been advised to limit their consumption of pilot whale meat and blubber.

In 1989 the health authorities in the Faroes were made aware of high levels of organochlorines in the blubber of pilot whales. The average PCB concentration in two schools of pilot whales harvested in 1987 was 27 µg/g lipid and of DDT 19 µg/g lipid. For this reason, the health authorities in 1989 recommended the general

population to consume only 150–200 g of whale meat per week and only 100–200 g blubber per month. Further, they recommended abstaining completely from eating liver and kidneys.

A cohort of 1022 consecutive births was generated during 1986–87, covering the whole community. Increased methylmercury exposure from maternal consumption of pilot whale meat was indicated by mercury concentrations in cord blood (median 24.2 µg/l) and in maternal hair (median 4.5 µg/g). At approximately 7 years of age, 917 of the children underwent detailed neurobehavioral examination. Effects on brain function associated with prenatal methylmercury exposure appeared widespread (3).

Recommend reduction in consumption

Based on the demonstrated effects of mercury exposure and on a general assessment of Polychlorinated biphenyls (PCBs), the following diet recommendations were issued in 1998 (4): “High PCB contents in blubber leads us to recommend that adults at the maximum eat pilot whale blubber once to twice a month. However, the best way to protect foetuses against the potential harmful effects of PCBs, is if girls and women do not eat blubber until they have given birth to their children. The mercury content of pilot whale meat is high and is one of our main mercury sources. Therefore we recommend that adults eat no more than one to two meals a month. Women who plan to become pregnant within three months, pregnant women, and nursing women should abstain from eating pilot whale meat. Pilot whale liver and kidneys should not be eaten at all”.

Discovering the health effects

Several birth cohorts have been established in the Faroes in order to discover the health effects related to mercury and organochlorine exposure:

Cohort 1

A cohort of 1022 singleton births was assembled in the Faroe Islands during a 21-month period of 1986–1987. The children have been examined at age 7, 14 and 23 years of age.

Decrements in attention, language, verbal memory, and, to a lesser extent, in motor speed and visuospatial function, were associated with the mercury exposure. This association was still evident after the exclusion of high exposure subjects. As an objective neurophysiological parameter, delays on brainstem auditory-evoked potentials were also associated with increased exposures. Exposure-related decrease in heart rate variability and a tendency of increased blood pressure were also found. Findings were replicated at age 14 years, when cohort members were examined by comparable methods. Adjustment for polychlorinated biphenyls exposure did not materially affect the mercury effects.

Cohort 2

The findings from Cohort 1 suggested that exposure assessment should encompass several lipophilic pollutants in addition to methylmercury. As a follow-up, Cohort 2 was therefore established during a 12-month period in 1994–1995 and included 182 singleton term births from consecutive births at the National Hospital in Tórshavn, Faroe Islands. Relevant obstetric data were obtained by standardized procedures and supplemented by a brief nutrition questionnaire. These children were first examined by the Neurological Optimality Score at age two weeks (adjusted for gestational age), and then again at 7 months of age. Subsequent examinations were at age 18 months and then at 12 month intervals up to age 120 months. At 42 months, a comprehensive medical examination with the Neurological Optimality Score was included. For comparison with Cohort 1, detailed neurobehavioral tests were carried out at age 7 and 10 years.

Cohort 3

New insight into health risks caused by environmental pollutants and changing exposure patterns in the Faroes lead to the formation of Cohort 3 from consecutive births at the main hospital in the capital Tórshavn between 1 April, 1998 and 29 February, 2000. Because of dietary recommendations from the Faroese health authorities, methylmercury exposures had now decreased thus allowing better characterization of possible effects of PCBs and other lipophilic contaminants. Cohort 3 consists of 547 children. Nutritional habits were recorded by questionnaire (number of whale meat dinners per month during pregnancy and before pregnancy; number of fish dinners per week; ingestion of blubber with whale meat or fish). A subgroup of Cohort children was examined with regard to immunological parameters at ages 11 and 18 months. The first comprehensive medical examination was carried out just before the booster vaccination at age 5 years, with a follow-up blood sample one month after vaccination. The children were again examined at age 7 years.

Cohort 4

In order to estimate the effect of the dietary recommendations given in 1998, pregnant women in third trimester of pregnancy were invited to participate in a dietary survey. In total 148 women participated from October 2000 to September 2001. To cover the daily variation 24-hour recall questionnaire were used on three different days. Food diary where all food consumed during one day at a time was reported in total 732 times. To adjust for seasonal variation the women answered a food frequency questionnaire covering the last 12 months with special emphasis on traditional Faroese food items. Blood samples were analysed for mercury and organochlorines.

Table I. Total mercury in umbilical cord blood in Faroese cohorts in µg/l

Cohort	Year	n	Geometric mean	Min.	Max.
Cohort 1	1986–1987	894	22.9	0.90	351
Cohort 2	1994	163	20.9	1.90	102
Cohort 3	1998–2000	603	12.3	1.60	193
Cohort 4 (mother-serum)	2000–2001	148	1.86	0.001	7.50
Cohort 5	2007–2009	490	4.59	0.77	44.5

Cohort 5

Due to the fact that the contaminant exposure has changed greatly over the last two decades a new birth cohort of 490 children was established from October 2007 to April 2009. It was anticipated that the dietary warnings to pregnant women and not the contaminant concentrations in pilot whale meat and blubber had led to a significant reduction in methylmercury in the blood of pregnant women. However, without a simultaneous reduction in the concentrations of organochlorines. The children were examined by a paediatrician at the age of 2 weeks and 18 months with special emphasis on the central nervous system and the immune system. Blood samples were collected to be analysed for contaminants and vaccination antibodies, since previous studies in the Faroes have indicated an effect on the immune system by POPs.

Gloomy results

The results of the above mentioned studies together with studies on the adult populations have revealed an even gloomier picture of the adverse health effects that are caused by contaminants in pilot whale meat and blubber.

In short the results have so far shown that:

- Mercury from pilot whale meat adversely affects the foetal development of the nervous system (3).
- The mercury effect is still detectable during adolescence (5,6).
- The mercury from the maternal diet affects the blood pressure of the children (7).
- The contaminants of the blubber adversely affect the immune system so that the children react more poorly to immunizations (8–10).

- Contaminants in pilot whales appear to increase the risk of developing Parkinson's disease in those who often eat pilot whale (11).
- The risk of hypertension and arteriosclerosis of the carotid arteries is increased in adults who have an increased exposure to mercury (12).
- Septuagenarians with type 2 diabetes or impaired fasting glycaemia tended to have higher PCB concentrations and higher past intake of traditional foods, especially during childhood and adolescence. Impaired insulin secretion appears to constitute an important part of the type 2 diabetes pathogenesis associated with exposure to persistent lipophilic food contaminants (13).

Further studies

Currently, studies are underway to examine the fertility of the population since suspicion has been raised that reproductive functions may be decreased because of contaminants in pilot whale meat and blubber.

These observations should be considered in a global perspective. Mercury in the oceans has been augmented, and for example, polar bears now have a hair-mercury concentration that is about 10-fold greater than during earlier times. PCBs have been added as an environmental toxicant in the second part of the 1900s, but after bans about 1980 the concentrations in pilot whale have not yet decreased much. The pesticide metabolite DDE is also a new environmental chemical, and the parent compound DDT is still in use in other regions of the world. In addition, new compounds such as the organic fluorine compounds that are used for textile impregnation and other purposes are now found in increased concentrations in the blood in children, who eat pilot whale (14).

Table II. Comparing Faroese cohorts

Cohort	Cohort 2 (1994–1995)	Cohort 3 (1998–2000)	Cohort 5 (2007–2009)
Serum ΣPCB* (µg/g)	1.12 (0.62–1.87)	1.21 (0.80–1.81)	0.42 (0.25–0.78)
DDE (µg/g)	0.72 (0.4–1.21)	0.54 (0.34–0.94)	0.13 (0.07–0.29)
Mercury in cord blood (µg/L)	20.4 (11.8–40.0)	12.35 (7.07–20.81)	4.60 (3.02–6.74)
Mercury in maternal hair (µg/g)	4.08 (2.45–7.35)	2.14 (1.22–3.96)	0.70 (0.43–1.10)

*ΣPCB = (PCB 138 + 153 + 180) × 2; geometric mean (25–75%).

The latest analyses show that the mercury concentration of pilot whale remains high with an average of about 2 micrograms per gram. In the EU, the highest limit value of 1 microgram per gram is only applicable to the most contaminated species of fish. This limit is exceeded by most pilot whales. If we rely on the U.S. Environmental Protection Agency's limit for total dietary intake at 0.1 microgram mercury per kilogram body weight (which is based upon the research carried out in the Faroes), an adult person weighing 70 kg can consume only 3.5 gram of pilot whale meat per day to reach the limit value (15).

Blubber still contains high levels of several persistent organic compounds, such as PCBs and DDE. The average concentrations of both PCB and DDE are higher than 10 microgram per 160 gram of blubber. In regard to PCB, there are several limit values. Most of the limit values regarding PCB are below 1 microgram per gram.

It can therefore be concluded that pilot whales today contain contaminants to a degree that neither meat nor blubber would comply with current limits for acceptable concentrations of toxic contaminants. The Faroese body burden of pollutants is also high seen in an international perspective. However, the most recent studies have shown that pregnant women eat much less pilot whale meat and blubber than before. This change has resulted in a significant decrease in mercury and POP concentration in the blood of pregnant women, Table I and Table II. Mercury in Table I is measured in umbilical blood, which is approximately 25% higher than in maternal blood. In order to avoid reporting all the measured PCB congeners, serum PCB is reported as the sum of the congeners number 138, 153 and 180 multiplied by two – this value is close to sum of all the measured congeners.

Consumption no longer recommended

The growing scientific documentation has, during recent years, given rise to the anticipation that the time was approaching when it would be appropriate to recommend against any human consumption of pilot whale meat and blubber.

From the latest research results, the authors consider that the conclusion from a human health perspective must be to recommend that pilot whale is no longer used for human consumption (16).

It is with great sadness that this recommendation is provided. The pilot whale has served the Faroese well for many hundreds of years and has likely kept many Faroese alive through the centuries. But the times and the environment are changing, and we therefore believe that this recommendation is necessary from a human health point of view.

We in the Faroe Islands are not responsible in regard to the marine pollution, which has been inflicted upon us from outside. That research in the Faroes has contributed to the current focus on this contamination is a bitter

irony. These results have already led to reduced limit values on methylmercury in other countries (15). We must therefore also ourselves acknowledge the consequences and act according to the precautionary principle expressed in The Faroes Statement (17). The demonstrated great reduction in exposure levels among pregnant women in the Faroes must be considered a successful outcome of two decades public health communication regarding marine pollutants.

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