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l'Association pour la santé publique de l'Ontario  
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# **Position on Fish Consumption, with respect to Methylmercury Content, by Pregnant Women, Women of Childbearing Age and Young Children**

**Position paper and resolution adopted by the  
Ontario Public Health Association (OPHA)**

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## Executive Summary

Mercury and its biological form methylmercury (MeHg) is a potent toxin in our food supply, found almost exclusively in fish and shellfish. It is a persistent organic pollutant in the environment and accumulates in organisms that ingest it. Mercury is designated a “toxic substance” under the Canadian Environmental Protection Act (CEPA) (55a). Regulation of, and advisories about, mercury in fish are federal and provincial responsibilities. However, public health concerns are being raised at the municipal level for the following reasons. Strategies for action by OPHA and its partners are based on these facts and concerns.

- i. **Negative Health Effects of Methylmercury:** Ingested MeHg impairs neural and other development in unborn and growing children, even at small, chronically accumulative levels. A fetus is especially at risk in the first trimester. In Canada, 37,500 children may currently be at risk (55a). Adults are also affected when their bodies accumulate mercury at unusually high levels.
- ii. **Positive Health Effects of Fish Consumption:** Fish are an excellent source of high-quality protein and omega-3 fatty acids, essential for optimal brain and cardiovascular development (21). Several recent advisories (17, 42, 58) encourage more frequent consumption of fish by the entire population, especially fatty fish that is low in mercury. The protective effects against cardiovascular disease and intrauterine growth retardation are thought to outweigh the effects of very low exposure to mercury (11, 26, 39).
- iii. **Trend of Increased Fish Consumption and Availability:** Although fish is not generally consumed as a staple food in Southern Ontario, some types, notably canned tuna, are consumed frequently by some adults and children. Overall fish consumption has grown in Ontario over the past decade (Stats Can 2003). Some possible reasons for this are:
  - ?? Canned tuna is inexpensive, and is frequently distributed through food banks.
  - ?? Fresh fish known to be high in methyl mercury is available in local food stores and markets.
  - ?? Public messages regarding the *protective* effects of fish due to its nutritional value have been widely accepted (i.e. optimal fetal development; protection against cardio-vascular disease)
  - ?? High protein diets for weight loss have become very popular among people of all income levels. Fish consumption is compatible with this diet.
- iv. **Evidence of Population Risk:** Canadian data on blood mercury levels exist only for some Aboriginal Peoples. However, a recent study (April 2003) of the American general population showed that approximately 8% of pregnant women had cord blood mercury levels at or above the “reference

dose” (a maximum standard set in 2003 by the US National Research Council and Environmental Protection Agency).

- v. **Lack of Public Awareness of Risk:** Public education about federal/provincial restrictions on fish consumption and about local fish advisories is available but is not well promoted (41).
- vi. **Environmental Trend:** According to many indicators, MeHg in the global environment continues to increase steadily, resulting in higher concentrations in fish caught world-wide. Most fish eaten in the Ontario are imported from global markets (Canadian Food Inspection Agency).
- vii. **A Need for Updated, Clear Guidelines:** On-going analysis and application of new information is needed, including data and standards from international sources. Such information may be controversial, and may require synthesis of multi-disciplinary issues (e.g. environmental, economic, social, toxicological, nutritional) in order to be adapted locally.
- viii. **A Need for Advocacy:** The development of guidelines to protect the public depends on the provision of data, including (i) the content of mercury in marine fish and seafood sold in Canada and (ii) specific food intake patterns of the Canadian population by vulnerable demographic subgroups, e.g. pregnant women, young children, foodbank users, etc. Currently, recent Canadian data is publicly available only for freshwater sports fish and for household food expenditures. In terms of environmental root causes, global mercury reduction can only happen if all countries, including Canada, cooperate in effective international environmental reduction strategies.

## **Background**

### **1. Sources of methylmercury**

Mercury exists in nature, but industrial activities have resulted in its concentration in parts of the ecosystem where it previously was not found. Globally, approximately 2,200 tons of inorganic mercury are released annually into the air, water and soil each year from the combustion of fossil fuels (70% from coal-fired power plants), industrial and mining sources, waste incineration, mercury-based seed-treatment fungicide and dumping or burning of products containing mercury (45, 47, 65b).

Once released into the atmosphere, mercury can travel long distances with prevailing winds. When it is deposited in lakes, rivers and oceans, aquatic microorganisms transform it into **methylmercury (MeHg)**, its organic and most toxic form. MeHg *bio-accumulates* up the food chain, first in smaller marine animals and fish, and eventually in larger predatory fish where it can be concentrated many thousand-fold. MeHg is stored in the muscle part of fish, therefore trimming the fat from fish does not reduce mercury concentration.

The UNEP (United Nations Environment Program) Global Mercury Assessment Working Group, an assembly of about 150 experts concluded in 2002 that “there is sufficient evidence of significant global adverse impacts to warrant international action to reduce the risk to human health and the environment arising from the release of mercury into the environment” (48).

### **2. Toxicology of methylmercury**

Consumption of fish and marine mammals is the single most important source of human exposure to methyl mercury. About 99% of mercury in fish is MeHg. In the human digestive tract, about 95% of MeHg in food is absorbed (27). MeHg accumulates in animal and human tissues faster than it is excreted (its half-life is about 50 days). As it is water soluble (12), it passes through the blood-brain and placental barriers, and becomes more concentrated in the fetus than the mother (44). The fetal brain is more susceptible than the adult brain to MeHg-induced damage, as it inhibits the division and migration of neuronal cells (3, 47a).

Once in the central nervous system, MeHg can be demethylated to inorganic mercury, which persists even longer in the body. MeHg is deposited in almost all tissues, binds to red blood cells, and can be measured in hair, nails, breast milk, maternal blood and cord blood. The concentration of mercury in breast milk is approximately 5% of the mother’s blood mercury concentration (38). It can potentially cause damage from occasional large doses or chronically-ingested small doses. Cord blood MeHg is approximately twice as high as maternal blood in late pregnancy (29). Among pregnant women in South Western Quebec, a strong dose relation was observed between frequency of fish consumption before and during pregnancy and MeHg in maternal hair and cord blood (22). Adverse

effects in children are believed to occur when the pregnant mother's blood mercury level is more than 15 micrograms per liter (ug/L). After stopping or reducing consumption of fish high in mercury, blood levels gradually decline over a period of months (14).

### **3. Health outcomes of methylmercury ingestion**

Traces of mercury are found naturally in organic tissues without consequence, but chronic consumption of larger than natural amounts results in toxicity. Fetal exposure to MeHg is of special concern, since it causes the destruction of neural cells in the developmental stage.

Strong scientific evidence exists, from international human epidemiological studies, that links certain levels of MeHg exposure *in utero* with irreversible, neurological problems in infants and children (5, 9, 18, 28, 24). Outcomes range from poor performance on tests that measure attention, visual-spatial ability, motor function and language (e.g. delayed walking and speech) to blindness, deafness, seizures, cerebral palsy and death (19). These studies have formed the basis for setting standards for mercury exposure.

In Canada in 2003, increased incidence of cerebral palsy among male infants in the Great Lakes basin have been associated with elevated levels of mercury in that area (7).

In older children and adults, chronic and/or high mercury exposure has neurological, renal, cardiovascular and immunological impacts (10, 24). Symptoms of chronic or high MeHg exposure include memory loss, decreased concentration, tunnel vision, fatigue, muscle and joint pain, and impairment of immune, cardiovascular and reproductive systems (13, 14, 87).

### **4. Methylmercury in humans**

#### **(a) WHAT LEVEL OF METHYLMERCURY IS CONSIDERED TOXIC IN HUMANS?**

See Table 1, Appendix A, p. 13

#### **(b) HOW MUCH METHYLMERCURY IS ACTUALLY FOUND IN HUMANS?**

See Table 2, Appendix A, p. 14

#### **Summary of tables 1 and 2:**

The most recent and most widely accepted "upper safe limit" of total mercury in human blood is 5.8 ug/L (ppb). The amount of MeHg actually found in humans varies greatly, depending on the amount and type of fish consumed. Most population-wide assessments (in the UK and USA) have yielded blood levels well below this level. However,

subpopulations, such as northern Aboriginal communities, Great Lakes fishers and eaters of Asian descent, and a sample of “high-end” fish consumers in California have shown blood mercury levels considerably higher than this.

## **5. Methylmercury in fish**

### **(a) WHAT LEVELS OF MERCURY ARE CONSIDERED ACCEPTABLE OR TOXIC IN FISH?**

See Table 3, Appendix A. p. 15

### **(b) HOW MUCH METHYLMERCURY HAS BEEN FOUND IN VARIOUS TYPES OF FISH?**

#### **(i) CANADA, CFIA, 2003 (personal communication)**

The CFIA has laboratories in BC, Ontario and the Maritime provinces equipped for testing for mercury in commercial fish and seafood destined for retail in Canada ([www.inspection.gc.ca](http://www.inspection.gc.ca)). Shark, swordfish and fresh tuna are rarely tested because they are known to be high in MeHg, and a consumption advisory exists. Five percent of canned tuna shipments (as well as marlin, sea bass and mahe mahe) have a random sample tested for mercury content. If these are found to contain more than 0.5 ppm mercury, the fish cannot be sold.

Over time, smaller tuna have been used for canning, because smaller fish are now more available than larger ones. Skipjack and Yellowfin tuna are generally smaller and therefore lower in mercury – well below the action level of 0.5 ppm (see table 4). The larger Albacore or Bluefin tuna are considerably higher in mercury, with samples on the maximum end exceeding the action level. “Flaked” canned tuna is lower in mercury than “solid, white”, because smaller fish are used.

According to information sent by the CFIA laboratory in BC, Canada, who inspect imported fish, canned albacore tuna in 2002 averaged 0.37 ppm.. – just below the 0.5 ppm cut-off point. Samples ranged from a minimum of 0.18 to 0.64 ppm.. In contrast, the smaller yellowfin and skipjack tuna, labeled as “light” on the cans, averaged only 0.05 ppm and 0.06 ppm respectively.

See Table 4, appendix A, p. 15

#### **(ii) ONTARIO, Ministry of Natural Resources**

*Guide to Eating Ontario Sport Fish, 2003 (62)*

Fresh water lakes may contain a number of contaminants including PCBs and pesticides, but the primary pollutant to cause consumption restrictions is mercury. The *Guide to Eating Ontario Sport Fish*, which is revised every 2 years, does not provide actual mercury or MeHg values. For every lake in Ontario, it lists major fish that are found, with symbols to denote the recommended frequency of consumption.

A clear fish symbol indicates fish that can be eaten, no more than 4 meals per month, by women of childbearing age and children under 15 years. A dark fish symbol means that a certain species and size of fish should not be consumed at all by anyone. Species most commonly listed as “not to be consumed” are larger sizes of: Walleye, Largemouth Bass, Smallmouth Bass, Lake Trout, Brown Trout, Northern Pike and Muskellunge. The *Guide* recommends eating smaller fish only.

According to a report by Environment Canada (52), the CFIA and some provinces are placing increasing responsibility upon the fishing industry and independent researchers to analyze contaminants in fish. Although the CFIA conducts routine audits, federal and provincial departments depend on notifications by industry if contaminants indicate a possible health concern.

A two-page summary of the *Guide to Eating Ontario Sport Fish* is available in French, German, Portuguese, Spanish, Polish, Ukrainian, Korean, Mandarin, Cantonese, Japanese, Hungarian, Italian, Vietnamese and Cambodian. They can be ordered from the Sport Fish Contaminant Monitoring Program ([sportfish@ene.gov.on.ca](mailto:sportfish@ene.gov.on.ca)) or obtained on-line (<[www.ene.gov.on.ca](http://www.ene.gov.on.ca)>).

**(iii) US FDA** (Food & Drug Administration), Center for Food Safety & Applied Nutrition, Office of Seafood (40).

See table 5, Appendix A, p. 16

**(iv) UK FSA** (Food Standards Agency), 2002 (38)

* Swordfish: mean mercury level:	1.36 ppm
** Shark: “ “	1.52 ppm
*** Fresh tuna: mean mercury level:	0.40 ppm
☞ Canned tuna “ “	0.19 ppm

**(v) Mercury Policy Project (MPP), June 2003** (35)

MPP's independent testing found that mercury levels in "white," or albacore, canned tuna averaged over 0.5 ppm. Albacore accounts for about one-third of all canned tuna sold in the U.S.

### **Summary of Tables 3 – 5:**

In terms of mercury levels in commercial fish, Health Canada has set the upper safe limit at 0.5 ug *total mercury* per gram of fish (or ppm) sold in Canada. It is more than twice as sensitive as the USA limit of 1.0 ug *MeHg* per gram. This limit does not apply to large predatory fish, however, as these are known to regularly exceed the upper safe level. Instead, an advisory exists which warns women who are pregnant, or planning to be pregnant, and children under 15 to limit their consumption of shark, swordfish and fresh or frozen (not canned) tuna to one meal per month. This advisory appears on the CFIA website.

The amount of mercury in commercially-sold fish in Canada is not publicly available. Canned tuna is subject to random testing by CFIA labs, and is variable in its mercury content. Some albacore tuna has been tested at above the allowable limit, but would have been stopped from retail distribution.

The amount of mercury in Ontario fresh water fish is not publicly available either. Instead, the Ontario Ministry of the Environment issues an advisory (in a pamphlet and on their website) that “women of childbearing age and children under 15 should restrict consumption of sport fish caught in Ontario waters to no more than 4 meals per month”. Some species of fish in certain lakes have a mercury content high enough to be unacceptable for human consumption; these can be identified by a special symbol in the publication *Guide to Eating Ontario Sport Fish*.

US FDA data for mercury in fish have recently been made available (in 2004), but many are over 10 years old. They acknowledged the higher levels of mercury in albacore or white tuna (40). Recent (2002) data from the UK showed higher levels of mercury for the large predatory fish, although the values for fresh and canned tuna are similar to those of the US.

## **6. Nutritional and cultural benefits of fish**

Fish are an excellent source of high-quality protein and long-chain omega-3 fatty acids (alpha-linolenic acid, EPA, DHA), essential for optimal brain and cardiovascular development (21). In 1999, the US EPA and TERA (Toxicology Excellence for Risk Assessment) produced a detailed report, *Comparative Dietary Risks: Balancing the Risk and Benefits of Fish Consumption* (39). The report provides data on the nutritional content of several types of fish, including omega-3 fatty acids. The authors developed a framework to estimate the relative risk, resulting in a **Fish Consumption Index**. They concluded that “consuming fish that are smaller, younger or proven less contaminated may provide health benefits with minimum health risks”. They also pointed out, however, that significant gaps in information (especially contaminant content) currently prevent accurate estimates of benefits and risks for a larger range of fish.

The Heart and Stroke Foundation of Canada encourages people to eat fish regularly, and advises that women of childbearing age who are concerned about possible mercury contamination should eat smaller, canned fish like sardines, mackerel or salmon. A 2002 American Heart Association “scientific statement” summarized recent epidemiological evidence about the effects of omega-3 fatty acids on cardiovascular disease. Due to the substantial benefits, the AHA recommends eating 2 servings of fish per week. They also note that “the extent to which MeHg in fish may diminish the beneficial effects of omega-3 fatty acids requires further study” (11, 17).

A 2004 British report on fish consumption, produced jointly by COT (Committee on Toxicity) and SACN (Scientific Advisory Committee on Nutrition), strongly recommends the addition of one portion oily fish per week per person, to increase the intake of long-chain fatty acids and reduce the risk of heart disease (42). A study published that same year, with 11,585 pregnant women in SW England, showed that the incidence of intra-uterine growth retardation (IUGR) decreased with increasing fish intake (26).

Fish are an important part of the diet of many cultures. Some types, like canned tuna, are an inexpensive and nutrient-dense part of the diet, which is especially important for low-income families. Canned fish is one of the healthier foods commonly supplied by food banks, a source of high quality protein and essential fats which is not easily replaced.

## **7. Fish Consumption**

### **(a) WHAT DO FISH ADVISORIES SAY ABOUT FISH CONSUMPTION? (CANADA, UK, USA)**

#### **(i) Advisories for Marine Fish and Seafood**

See table 6, Appendix A, p. 17

#### **(ii) Advisories for Inland Sport Fish**

Current (2003) **Ontario Ministry of the Environment** advice (62, 63) for pregnant women, women of childbearing age, and children under 15 recommends:

- ?? Eating only those fish designated with a clear fish symbol in the most recent provincial guide for eating sport fish and consuming *no more than 4 meals of such fish per month*
- ?? Not eating fish designated with a dark fish symbol in the guide.
- ?? Not eating any other categories of fish caught in provincial lakes
- ?? Not consuming sport fish if already regularly consuming shark, swordfish or

fresh tuna;

?? Freely eating canned tuna because mean levels of MeHg fall below the upper limit

Other Canadian provincial sports fish advisories are available at [www.ec.gc.ca/mercury/r-fa-e.html](http://www.ec.gc.ca/mercury/r-fa-e.html).

In the USA, the **Environmental Protection Agency** (EPA) regulates sport-caught fish, and lists advisories on their website. Since May, 2003, the EPA has advised (56, 57):

- Women who are pregnant or may become pregnant and nursing mothers should limit their consumption of sport-caught fish to one 6-ounce meal per week
- Young children should consume  $\leq 2$  ounces of sport-caught fish per week.

In 2002, over 2,000 mercury advisories and safe eating guidelines were issued for coastal and fresh water fish by 45 US states (56). This represents over 12 million lake acres and almost 500,000 river miles contaminated by mercury.

#### **(b) HOW MUCH FISH DO PEOPLE EAT?**

- (i) Dietary surveys that include fish consumption have been recently done in the US (NHANES, 1999-2000) and the UK (2002). These surveys do not distinguish by types of fish eaten, but indicate that tuna, especially canned tuna, is the most widely eaten fish. They also found that seafood consumption has risen 25% from 1980 to 2000, mostly due to the promotion of its nutritional benefits, including those of omega-3 fats in pregnancy. The rise in large tuna consumption between 1997 and 1998 was due to increased popularity of fresh fish steaks and sushi (1, 43).
- (ii) Data from the US Seafood Industry estimates the average consumption, for the entire population, of 1 meal of tuna per person per month (table 7). Since many people do not eat tuna at all, it implies that some people likely eat several meals per month.

Table 7:

	<b>Average number of tuna meals per person in the USA in 1997</b>
Restaurant: tuna salad sandwich	0.3
Home: Base dish tuna	0.8
Home: Tuna salad	1.0
Home: Tuna casserole	2.4
Home: Tuna sandwich	7.4
<b>Total average meals/person/year</b>	<b>11.9</b>

(from 1998 Annual Report of the US Seafood Industry)

(iii) The Mercury Policy Project (35) states that:

- Canned tuna is consumed in 90% of American households and accounts for around 20% of US seafood consumption.
- Children eat more than twice as much tuna as any other fish, and canned tuna is the most frequently consumed fish among women of child bearing age.

(iv) In Canada, fish consumption in 2002 was estimated at just over 7 kg per person (46d). This is 16.4% higher than a decade earlier. Reasons cited by Statistics Canada were “a wider array of convenient and easy-to-prepare products and a demand for alternate sources of protein.”

Table 8: Statistics Canada (2001): **Apparent per capita food consumption in Canada** (46c)

	<b>Kilograms of edible weight consumed per person per year</b>	<b>Equivalent in grams per person per week</b>
Fresh and frozen sea fish	4.57	88
Processed sea fish (including canned)	2.45	47
Shellfish	2.13	41
Freshwater fish	0.42	8

Note: 1 serving fish = 3 oz or 88 grams  
 1 can tuna = 120 grams dry weight

Table 9: Statistics Canada (2001): **Weekly Household Food Expenditure on Fish, from Stores – Ontario**

Selected items and analysis from report Table 1d, page 19 (46a)

	<b>Ave. expenditure per week per household</b>	<b>Percentage of total fish</b>
Total fresh/frozen/cured fish	\$1.65	
Total cod (F=.09), flounder, sole haddock, salmon and precooked frozen fish (e.g. fish sticks)	1.10	45%
<b>“Other sea fish”</b> (assume inclusion of large predatory fish)	0.43	<b>18%</b>
Other – freshwater (F=.09) and cured	0.22	9%
Total canned fish	0.69	
<b>Canned tuna</b>	0.36	<b>15%</b>
Other canned fish	0.33	14%
<b>ALL FISH</b> (excluding other marine products)	\$2.44	100%

29% of Ontario and Toronto households reported buying fish and other marine products in 2001.

Table 10: Statistics Canada (2001): **Average Weekly Expenditure per Household on Food Purchased from Stores, by Income Group** (46a, pp.37 and 40)

	<b>&lt; \$20,000</b>	<b>\$20,000 – 39,999</b>	<b>\$40,000 – 59,999</b>	<b>\$60,000 – 79,999</b>	<b>≥ \$80,000</b>
Fish and other marine products	\$1.41	2.36	3.09	3.04	<b>4.52</b>
Canned tuna	0.13	0.25	0.32	0.28	<b>0.41</b>
Other sea fish (incl. large predatory fish)	0.15	0.29	0.38	0.40	<b>0.70</b>

- (v) In Canada, a study by researchers from Health Canada and the Pesticide Management Regulatory Agency (5a) looked at the mercury content of “total diet food composites” from Whitehorse (1998) and Ottawa (2000). Estimated dietary intakes were based on data collected in 1977 and 1993. Results indicated that out

of all foods, fish contributed “more than half of the ingested mercury”, but that all fish composites were below the guideline of 0.5 ppm total mercury. Only 8 samples of fish and fish products were tested in the study, and no distinction was made between species of fish. With this method, dietary intakes of mercury were estimated to average 0.022 ug/kg body weight/day (below the 0.2 ug/kg/day Canadian guideline for children and women of childbearing age).

The Statistics Canada data (iv) suggest that the amount of fish eaten in Ontario households, if estimated as a *population average*, is not large. The additional amount of fish eaten in restaurants was not supplied. It appears that fish that may contribute significant amounts of mercury are not, *on average*, heavily consumed. Similarly, the Health Canada data (v) are based on *average* dietary intakes from old data, and on composites of various types of fish from a very small sample size. When such information informs policy, it explains why mercury in fish is not treated as an issue of importance in Canada (apart from Northern communities). The Health Canada study did state that “there may be population subgroups among the eaters consuming substantially more fish, and routine surveillance of fish for mercury is necessary” (5a).

Other data from the above source suggest that fish consumption varies among subpopulations. For example, Torontonians had higher consumption of fish than average, possibly because of their large ethnic component.

In smaller cities in Ontario, average fish expenditure in 2001 was less than half than that of cities with a population of over 1 million. (46a., p.64). This statistic may change over time as smaller cities become more multi-ethnic in nature, or change their fish consumption behaviour for reasons of nutrition. As well, higher income households consumed more fish, including canned tuna and fresh/frozen fish, implying the inclusion of large predatory fish (table 9). Out of one-person households, females under 65 years spent more than males on commercial fish and marine products (p.55).

Still, household food expenditure data are of limited use for determining to what extent mercury is a problem for any specific subgroup in Canada, as they do not show the range of fish expenditures (only averages) and does not reveal differences by age or ethnic group. High-mercury fish is not singled out explicitly as a special category. As well, behavioural or demographic indicators of “high-end” consumers (other than income and ethnic group) would help identify subpopulations at risk.

**(c) HOW USEFUL ARE ADVISORIES REGARDING MeHg CONSUMPTION, GIVEN EXISTING DATA ON THE AMOUNT OF MERCURY IN FISH AND**

## ON FISH CONSUMPTION DATA?

The reference dose (table 6) is the amount of MeHg that any person, including pregnant women and children, can ingest daily without harm. It is given in micrograms MeHg per kg bodyweight per day.

*Effective* application of this safety standard for fish consumption by a defined vulnerable subgroup of the population requires *accurate* knowledge about (a) the mercury content of the fish, and (b) how much fish is consumed, on average, by that population group. Current advisories, however, are based on low average or mean values for MeHg in certain fish – data which is often very outdated, based on small sample sizes, limited to certain types of fish and not available to the public. Advisories in Canada are based on assumptions about average, population-wide fish consumption, derived from secondary data (not individual food intakes). They do not take into consideration new trends or patterns of food consumption (personal communication, John Salminen, Health Canada).

In summary, uncertainties exist about the usefulness of advisories regarding MeHg in fish, because:

- (a) current, well-sampled, transparent data on mercury in all varieties of fish do not exist in Canada and only to a limited degree in the US.
- (b) current, well-sampled data on food intake in a variety of vulnerable subpopulations do not exist in Canada, and only sporadically in the US.

The following examples illustrate how weekly consumption of albacore tuna would lead to an intake of MeHg that closely approximates the American (EPA) or Canadian (HP) reference doses. These calculations assume that one 120g can of albacore tuna, with the average mercury concentration of .37 ppm, contains 43 ug of mercury per can. Thus:

- ?? If a 140 pound (64 kg) woman eats 1 can of albacore tuna per week, she would consume the equivalent of 0.1 ug mercury/kg/day (equal to EPA's reference dose, or half of Health Canada's reference dose).
- ?? If a 70 pound (32 kg) child eats 1 can of albacore tuna per week, he/she would consume the equivalent of 0.2 ug mercury/kg/day (twice the EPA's reference dose, or equal to Health Canada's reference dose)

These amounts become proportionately higher when the child or woman is smaller (but eats the same amount), or when the fish contains a concentration of mercury closer to the upper range.

In the US, in the summer of 2003, joint meetings were held with interested parties to gather information for the “development of a joint FDA-EPA advisory for MeHg-containing fish consumption for women of childbearing age and children” (37).

Recommendations included increased monitoring of MeHg in fish and humans. A National Forum on Contaminants in Fish took place in January, 2004, in San Diego, California to create a national mercury advisory ([www.epa.gov/waterscience/fish/forum/2004/agenda.htm](http://www.epa.gov/waterscience/fish/forum/2004/agenda.htm)). The new advisory was released in March, 2004 (58) – see table 6.

Health Canada has no current plans to revise their reference dose or fish advisories, nor plans to change their data collection procedures (personal communication, John Salminen, Health Canada).

#### **(d) DO WARNINGS ABOUT FISH RESTRICTION REACH PREGNANT WOMEN AND WOMEN OF CHILDBEARING AGE?**

In March, 2000 the Fish and Wildlife Nutrition Project released a report for Health Canada, “*Communicating Fish Advisory Information: A Monograph*” (41). Over 3 years, 1,762 people who ate fish from the Great Lakes were interviewed, and 4,637 completed questionnaires about the fish they caught, their fish eating and cleaning practices and their attitudes and knowledge of contaminants in fish.

Although most fishers were male, they regularly shared fish with family and friends. For many fishers born outside Canada (38%), as well as Native Canadians, catching fish was an important link with their heritage and tradition. About a third of the fishers interviewed said they knew about the *Guide to Eating Ontario Sport Fish* (62); however, the researchers found no evidence that it was used as intended, namely to determine the maximum number of meals of particular fish people should consume per month.

The report recommended that the symbols and calculations in the Guide be revised to be more “user-friendly”, and to reflect the languages and literacy level of people who catch and eat freshwater fish. Consequently, the Guide was translated into 15 languages. It is available at government offices, by phone or on the internet, and at beer stores; the Health Canada report recommended that the information be distributed more widely.

In the US, a consumer survey in August 2003 (74) found that 45% of New Englanders were unaware of the FDA advisory that women of childbearing age and young children should not eat swordfish, tuna steak and certain freshwater fish because of mercury contamination. Fifty nine percent were unaware of state health department advisories that this same group should limit consumption of canned tuna.

According to a report by Environment Canada (52), “...there is not a consistent and uniform procedure for assessing, addressing and maintaining fish consumption advisories.” The report shows how procedures vary between all ten provinces and territories, as well as provincial and federal departments who play a role in monitoring mercury in fish and issuing public advisories. The authors recommend that, considering

the importance to health of informing the public about the hazards of mercury, a consistent and uniform procedure, as well as better interdepartmental communications, be established across the country.

In January 2003, the California Attorney General filed a lawsuit seeking to force 5 major supermarket chains “to provide clear and reasonable warnings” about the dangers of mercury in tuna swordfish and shark. As a result, in February 2003, signs near fish about the dangers of mercury in fish were posted by Safeway, Whole Foods, Trader Joe’s, Kroger’s and Albertson’s. The signs state:

*“Warning! Pregnant and nursing women, women who may become pregnant, and young children should not eat the following fish: swordfish, shark, king mackerel, tilefish. They should also limit their consumption of other fish, including fresh or frozen tuna. Mercury levels in canned tuna vary, but on average are lower than levels in many other fish. Chunk or chunk light tuna has less mercury than solid white or chunk white tuna” (85).*

In March 2003, the California Medical Association (CMA) adopted a resolution urging the Attorney General to label canned tuna because of its MeHg content, canned tuna being the most commonly consumed fish.

After reports of MeHg poisoning in San Francisco, CMA became concerned about the clinical implications for people who are being told to eat fish for health reasons (76).

In April 2003, the California Attorney General filed lawsuits against 18 California restaurants for not warning about mercury in seafood. The lawsuits seek to force restaurants to warn customers about Ahi (Yellowfin) tuna, Albacore tuna, swordfish and shark (78).

In June, 2004, the California Attorney General file a lawsuit against 3 tuna canning companies for failing to warn consumers about the exposure to mercury from eating canned tuna (81).

## **8. Trends in Levels of Mercury in the Environment**

Conflicting information exists about whether MeHg is decreasing or increasing in the environment, depending on which indicators are used and which years are cited.

According to *Canada’s submission to the UNEP Global Mercury Assessment (2001)*, the concentration of mercury in Great Lakes fish declined from the mid 1970’s to the mid 1980’s (47). The *Guide to Eating Ontario Sport Fish (62)* reports diminishing mercury concentrations in Lake Superior lake trout from 1976 to 2002, although this lake is the least contaminated.

From 1997 to 2001, the number of fish restriction advisories (due to mercury) for all Great Lakes increased. Similarly, in the US, fish consumption advisories increased from 28 to 40 states from 1993 to 2000 (43).

As well, the creation of reservoirs was noted as a major source of MeHg contamination of fish as mercury is released from the ground into water (47).

From 1990 to 1995, total Canadian man-made mercury emissions decreased from 32,945 to 11,109 kilograms per year, largely due to reductions from industrial resources (47). At the same time in the US, it is calculated that atmospheric mercury levels rose approximately 8% per year between 1990 and 1996 (43).

According to the *Canadian Council of Ministers of the Environment* (2002), “environmental levels of mercury have increased 1-3% per year since industrialization and recent measurements indicate that mercury levels are increasing again, due largely to increase societal energy demands. Overt signs of toxicity are not apparent in Canadians, but the threat of subtle impacts is real.” They also point out that Canadian standards are based on the Precautionary Principle (conclusive scientific proof of damage is not needed before guidelines are made and restrictions enforced) (52). Yet at a UN Environment Program meeting in Nairobi in February 2003, Canada, along with the USA and Mexico, voted against the mandatory limitation of mercury emissions (84).

The International POPs Elimination Network (IPEN) has forged an international community of non-government organizations (NGOs), scientists, health-affected groups and health professionals for the purpose of advocacy, calling it a “civil rights” and “environmental justice” issue related to the outcomes of industrial growth ([www.ipen.org](http://www.ipen.org)). POP stands for “persistent organic pollutants”.

## **Public Health-Related Implications and Recommended Actions**

According to the *US National Research Council report* (2000), public health implications are as follows:

“Because of the beneficial effects of fish consumption, the long-term goal needs to be a reduction in the concentrations of MeHg in fish rather than a replacement of fish in the diet by other foods. In the interim, the best method of maintaining fish consumption and minimizing mercury exposure is the consumption of fish known to have lower MeHg concentrations.” (44)

The **Food Advisory Committee of the FDA** (US) has recommended better data

collection on MeHg, to inform public health (2, 37) regarding:

- detailed assessment of canned-tuna consumption in the population
- assessment of the associated level of current MeHg exposure
- clarification of what is meant by “a variety of fish”
- specific dietary guidelines for children depending on age or size
- cooperation of federal and state agencies to include commercial and sports fish under the same advisory
- increased monitoring of MeHg levels in human blood and hair.

According to the **UNEP Global Mercury Assessment Working Group (2002)**, short term goals should be (48):

1. greater outreach to vulnerable groups such as pregnant women
2. strengthened cooperation among governments to share information about mercury risks
3. increased funding for research, monitoring and data collection

The **American Medical Association** adopted the following 4 policy statements at the April 2004 AMA Annual Meeting (30):

1. Women who might become pregnant, are pregnant, or who are nursing should follow federal, state, and local advisories on fish consumption. Because these advisories may differ, the most protective advisory should be followed.
2. Physicians should:
  - (a) assist in educating patients about the relative mercury content of fish and shellfish products;
  - (b) make patients aware of the advice contained in both national and regional consumer fish consumption advisories; and
  - (c) have sample materials available, or direct patients to where they can access information on national and regional fish consumption advisories.
3. Testing of the mercury content of fish should be continued by appropriate agencies; results should be publicly accessible and reported in a consumer-friendly format.
4. Given the limitations of national consumer fish consumption advisories, the Food and Drug Administration should consider the advisability of requiring that fish consumption advisories and results related to mercury testing be posted where fish, including canned tuna, are sold.

**Pollution Probe**, in *Mercury in the Environment* (45), recommends that pregnant women, breastfeeding women and children under 15 years never consume large ocean or freshwater fish, and eat fish in moderation that have lower mercury levels (e.g. haddock,

farmed trout, Pacific salmon, and flounder.)

**The Mercury Policy Project** (43) recommends:

1. testing of MeHg in seafood by government laboratories again
2. establishing regulatory limits based on current MeHg levels in fish and current fish intake of
3. subpopulations at risk
4. informing the public (in multiple ways, including point of purchase), especially subpopulations at risk
5. establishing policies to reduce mercury in the environment.

Other Specific Recommended Actions:

(a) **Prepregnancy Screening:** Because adverse effects in children are believed to occur when the pregnant mother's blood mercury level is more than 15 ug/L, pre-pregnancy screening is important for people who eat fish frequently (14).

(b) **More testing by government labs, and greater availability of data** (5a, 14, 34, 39, 43)

- MeHg in fish of all types, by size and source
- mercury levels in the environment
- dietary intake of fish, by types that correspond to advisories
- blood MeHg levels in vulnerable groups.

(c) **Public awareness through labelling or signage:** Many groups, including the California Medical Association, urge that information and advisories resulting from further testing be made readily available to consumers where fish is sold (76, 78, 85, 30).

(d) **Public awareness about sports fish advisories:** Specific pamphlets for children and pregnant women about Ontario sports fish advisories are produced. Planned distribution of this material through public health, the Canada Prenatal Nutrition Program, the Healthy Babies Healthy Children program and daycare centres could result in a larger number of this vulnerable population being reached.

(e) **An "ecosystem" approach to health effects of mercury in the environment** (8, 48a), through:

- epidemiological research to verify preliminary indications of harmful effects in people living in areas of concern
- evaluation of the efficacy of fish consumption advisories
- remedial action on contaminated sediments
- regulatory action to control sources of mercury in the environment

## **Recommendations for the Ontario Public Health Association**

It is recommended that OPHA adopt the following position regarding “fish consumption, with respect to methylmercury content, by pregnant women, women of childbearing age and young children”.

- 1.** Whereas fish has high nutritional value (a rich source of protein and omega-3 fatty acids essential for growth and neural development), and whereas some fish, canned tuna in particular, is widely consumed and generally inexpensive,

It is recommended that pregnant women and young children consume one serving per week of fish that is likely to be low in methyl mercury and high in omega-3 fatty acids: e.g. “light” canned (non-albacore) tuna, sardines, canned salmon, Pacific salmon, mackerel, herring, halibut, perch, trout, bass, scallops, shrimp.

- 2.** Whereas it is possible that some pregnant women and young children may be exposed to, or be accumulating in their tissues, potentially harmful amounts of mercury, because:
  - methylmercury is a toxin known to accumulate in tissues and to potentially harm fetal and early child development
  - methylmercury is present in high amounts in fresh predatory fish, which are commonly available in grocery stores and markets
  - methylmercury is present in fairly high amounts in canned albacore tuna, which is often low cost, commonly eaten frequently and commonly available from emergency food sources
  - fish advisories are not widely promoted and point of purchase warnings do not exist.

It is recommended that:

- (a)** pregnant women, those of childbearing age, and children limit their consumption of “white” (albacore) tuna to one can per month and avoid eating fresh or frozen predatory fish (tuna, marlin, swordfish, shark), and that
  - (b)** OPHA advocate that appropriate government ministries and other health-related agencies inform the public in a consistent, helpful way about methylmercury and its consumption for pregnant women, women of childbearing age and children under 15.
- 3.** Whereas Public Health staff cannot identify who is at risk, nor can they advise the public with certainty about how to remain at minimum risk, nor can they expect that citizens will be aware of the risk and take appropriate action, because uncertainties exist about the following:

- the amount of mercury that currently exists in various types of fish;
- the current range of blood mercury concentration in the Canadian population, especially in vulnerable subgroups;
- the amount of fish that people currently consume
- the amount of mercury in fish, and accumulation in bodies over time, that can affect human health
- difference in advisories in different countries and states.

It is recommended that OPHA, in partnership other interested organizations, advocate at the provincial and federal levels for:

- (a) more frequent data, available to public health, on mercury in all types of fish sold and caught in Canada
- (b) monitoring and surveillance of food intake of Canadians, including detailed information about fish consumption
- (c) coordination with other countries (especially the US FDA and EPA) to create consistent guidelines and advisories that are effective for both decision making and health outcomes of citizen groups vulnerable to high intakes of methylmercury.
- (d) development of guidelines to mandate labeling and point-of-purchase signage on high-mercury fish
- (e) reduction of mercury release into the environment.

**APPENDIX A: Tables 1 to 6**

**Table 1: STANDARDS FOR HUMAN BLOOD LEVELS OF MERCURY  
(LEVELS OF METHYLMERCURY CONSIDERED TOXIC)**

[ug/L = micrograms per liter = ppb = parts per billion]

	<b>Risk Category for Blood Levels in Humans</b>	<b>Based on:</b>
WHO, 1972 and Health Canada, 1979 (47)	<p>“increasing risk”: 20 – 100 ug/L (ppb) <i>MeHg</i> in blood</p> <p>“at risk”: &gt;100 ug/L (ppb) “</p>	
National Research Council, 2000 (44)  and  US EPA, 2003	<p>“benchmark dose”: 58 ug/L (ppb) CORD blood <i>Total mercury</i></p> <p><i>Results from average dietary intake of 1 ug MeHg/kg body wt/ day</i></p>	Evidence of developmental effects from in utero MeHg exposure in the Faroe Islands study (9).
	<p><b>Upper “safe” limit = 5.8 ug/L whole blood total Hg</b></p> <p>“estimated daily exposure that is likely free of risk for adverse effects over the course of a person’s life”</p> <p><i>This blood concentration results from average dietary intake of 0.1 ug MeHg/kg body wt/ day</i></p> <p>=“reference dose” (table 6)</p>	10-fold dilution of benchmark dose for safety factor

**Table 2: METHYLMERCURY FOUND IN HUMANS**

Human survey group	Sample studied	Blood Mercury Concentration
<b>Canada, 1970 – 95 (47)</b> <b>Northern Aboriginal communities</b>	N= 38,571 adults N= 2,405 newborns	> 20 ug/L <i>MeHg</i> 23% adults >100 ug/L 16% adults >20 ug/L cord blood 21.8% newborns
<b>Canada, 1993 - 96 (23)</b> <b>Québec and NWT</b>	Québec Nunavik Inuit N= 475 NWT Inuit and Dene N=176 S.Québec General Population N=1109	<i>Mean total mercury - Cord Blood</i> 14.2 ug/L 1.9 – 10.4 “ 1.0 “
<b>Canada , 2002 - 03 (4)</b> <b>Great Lakes Area</b> Anglers & eaters	N= 318 Euro-Canadians: 174 fish meals/yr. Asian-Canadians: 325 fish meals/yr.	<i>Mean total mercury:</i> 2.0 ug /L blood (ppb) <b>7.9</b> “
<i>Other Canadian populations or general population: A 5-year collaborative research project with 3 Canadian ecosystems is underway at the Université du Québec (54).</i>		No data available.
<b>USA</b> <b>CDC/ NHANES data</b> 1999-2000 (13, 36)  – general population	Children age 1-5 N= 1,250 Women age 16 – 49 N= 2,314 No fish eaten in 30 days studied ≥3 servings fish in past 30 days  <b>7.8% of women in sample</b>  <i>This means that about 7 million US women may have mercury levels higher than the reference dose; and an estimated 325,000 children in the US may be at risk for neurological development problems (43, 20).</i>	<i>Mean total mercury:</i> 0.30 ug /L blood (ppb) 1.30 “ <b>0.51</b> “ <b>1.94</b> “  <b>≥ 5.8 ug/L blood</b>  (higher than reference dose)
<b>UK, 2002 (38)</b> <b>National Diet &amp; Nutritional Survey</b>	N= 1,364 adults age 19- 64	1.6 ug/L blood = Mean 5.9 ug/L “ 97.5 <sup>th</sup> percentile
<b>USA</b> Study of “high-end” fish consumers 2003 (14) i.e. Frequent fish consumption incl. large predatory fish	N= 89 (incl. 66 female adults)	<b>15.0</b> ug/L blood = <b>Mean for women</b> ≥ 5.0 ug/L blood 89% ≥ 10.0 ug/L “ 54% ≥ 20.0 ug/L “ 16%

**Table 3: LEVELS OF MERCURY CONSIDERED ACCEPTABLE OR TOXIC IN FISH**

	Upper “safe” limit for commercial or sport fish TOTAL mercury [“Action Level”]		“Gourmet” high mercury fish (shark, swordfish, fresh/frozen tuna)	Fish = “not suitable for consumption”
<b>Health Canada</b> standard, 1971 (still current) -Tested by Canadian Food Inspection Agency (CFIA)	$\leq$ <b>0.5 ppm</b> <i>total mercury</i>	$\leq$ 0.5 ug/gram fish	<i>Exempt from 0.5 ppm limit, because they are known to exceed it. These fish are not tested; instead, an advisory on restriction of consumption is issued.</i>	>1.5 ppm
<b>Gov’t of Ontario</b> Inland Sport Fish (62)	<b>&lt;0.45 ppm</b>	<0.45 ug/gram fish	--	>1.57 ppm
European Community Regulation	$\leq$ <b>0.5 ppm</b>	$\leq$ 0.5 ug/gram fish	$\leq$ 1.0 ug/gram fish	--
<b>USA (FDA)</b> -since 1979	$\leq$ <b>1 ppm MeHg*</b>	$\leq$ 1 ug/gram (any) fish <i>Not legally enforceable. Derived from advised maximum human consumption of 0.47 ug MeHg/kg/day. This public advisory was recently lowered (Apr. 2003) – See table 6.</i>		

\*FDA action level was set at 0.5 ppm in 1969, but a lawsuit filed by the fishing industry resulted in raising the amount of mercury considered safe to 1 ppm in 1979 (43).

**Table 4: MERCURY (total, ppm) IN IMPORTED CANNED TUNA – BY SPECIES**

The following Canadian information was sent by the CFIA laboratory in BC: (2002 CFIA Product Verification Project)

<b>Species</b>	<b>No. of samples</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Average</b>	<b>Median</b>
<b>Albacore</b>	98	0.18	<b>0.64</b>	<b>0.37</b>	0.35
<b>Yellowfin</b>	62	0.01	0.21	<b>0.05</b>	0.04
<b>Skipjack</b>	120	0.01	0.22	<b>0.06</b>	0.05

**Table 5: “MERCURY LEVELS IN SEAFOOD SPECIES” 1978 - 2003**

US FDA (Food & Drug Administration), Center for Food Safety & Applied Nutrition, Office of Seafood (40).

NOTE: In the US, since 1999, was a moratorium on testing of mercury in seafood by the FDA. Most mercury testing is done and paid for by the fishing industry and is therefore proprietary information.

Species	Mean mercury level (ppm)*	Range (ppm) (ND = no data)	Sample size	Most recent year	% > .5 ppm Hg
Tilefish	1.45	0.65 – 3.73	60	1978	
King Mackerel	0.73	0.23 – 1.67	213	2000	
Swordfish*	1.00	0.10 – 3.22	605	2002	76% (21)
Shark**	0.96	0.05 – 4.54	351	2002	59% (21)
Marlin	0.49	0.10 – 0.92	16	2002	
Tuna (fresh or frozen)***	<b>0.38</b>	ND – 1.30	131	2002	66% (21)
<b>Tuna –canned:</b> <b>Light</b> (yellowfin, skipjack, tongol) <b>White</b> (albacore, bluefin)	<b>0.12</b>	ND – 0.85	131	2003	Approx. 8% (14)
	<b>0.35</b>	ND – 0.85	179	2003	
Anchovies	0.04	ND - .34	40	1978	
Cod	0.11	ND – 0.42	20	2003	
Haddock	0.03	ND – 0.04	4	2002	
Herring	0.04	ND – 0.14	38	1978	
Lobster – variable	Mean = 0.09 (Spiny) to 0.31 (N. Am.)			2002	
Mackerel - variable	Mean = 0.05 (N.Atl.) to 0.45 (Mexico)			1978	
Oysters	ND	ND			

Position on Fish Consumption, with respect to Methylmercury Content, by Pregnant Women, Women of Childbearing Age and Young Children

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Ocean Perch	ND	ND			
Pollock	0.06	ND – 0.78	37	2002	
Salmon – canned	ND	ND			
Salmon – fresh/frozen	0.01	ND – 0.19	34	2002	
Sardines	0.02	ND – 0.04	22	2003	
Scallops	0.05	ND – 0.22	66	1978	
Shrimp	ND	ND			
Squid	0.07	ND – 0.04	200	1978	
Trout	0.03	ND – 0.13	17	2003	
Whitefish	0.07	ND – 0.31	25	2003	
Bass	0.27	0.06 – 0.96	35	2003	
Bluefish	0.31	0.30 – 0.14	22	2003	
Grouper	0.55	0.07 – 1.21	22	2003	
Halibut	0.26	ND – 1.52	32	2002	
Orange Roughy	0.54	0.30 – 0.80	26	2003	
Snapper	0.19	ND – 1.37	25	2003	

ppm

=

ug/gram

**Table 6: ADVISORIES FOR MARINE FISH AND SEAFOOD**

Source	Methylmercury dietary intake “REFERENCE DOSE”	FISH intake: Advice to pregnant women, women of childbearing age and children (max. age varies)		
		High mercury, predatory fish	Other fish thought to be lower in MeHg	Canned tuna
Joint FAO/WHO (JECFA) 1972, 1989, 2000 FDA before 2003  JECFA June 2003 (49)	<b>0.47 ug/ kg /day*</b>  <b>0.23 ug/ kg/ day*</b>	--	--	--
<b>Health Canada, 2001 (64)</b>	<b>0.20 ug /kg /day</b> for pregnant women, women of childbearing age and children <15 yrs <b>0.47 ug /kg /day</b> for general population	Limit 1 meal/ month shark, swordfish, fresh/frozen tuna	Consume freely	Consume freely

<p><b>US EPA – 1996</b> (Supported by NRC, 2000)</p> <p><b>EPA/ FDA, March 2004 (58)</b></p>	<p><b>0.10 ug /kg /day</b></p>	<p>Do not eat shark, swordfish, king mackerel, tilefish</p>	<p>“Eat up to 12 oz. (2 average meals) per week of a variety of fish &amp; shellfish that are lower in mercury”</p>	<p>“You may eat up to 6 oz. (1 ave. meal) of albacore tuna per week” (as part of your 2 fish meals per wk)</p>
<p><b>12 US states in 2002</b></p> <p>(56, 79, 34, 82)</p>		<p>Do not eat shark, swordfish, tilefish, king mackerel</p> <p>(this includes breastfeeding women)</p>	<p>Each week, you can eat: -Up to 1 lb. ocean fish -Up to 1 lb. fresh, frozen, canned fish &amp; shellfish in stores and restaurants (51)</p>	<p>More stringent restrictions than FDA on canned tuna consumption</p> <p><b>Max (approx) 1 can/ wk</b></p>
<p><b>UK FSA, 2004</b> (Food Standards Agency)</p> <p>and</p> <p><b>COT, 2004</b> (Committee on Toxicity) (38,42)</p>	<p><b>0.23 ug /kg /day (1.6 ug /kg /week)</b> for pregnant women + women who may become pregnant</p> <p><b>0.47 ug /kg /day (3.3 ug/kg/week)</b> for all other people including breastfeeding mothers</p>	<p>Avoid shark, marlin, &amp; swordfish.</p>	<p>Fresh tuna MAX per WEEK: (PTWI*) Children &lt;16 yrs and Pregnant/lactating women: 2 tuna steaks/week @140 g</p>	<p>Canned tuna MAX per WEEK: (PTWI*) Children: No restriction. Pregnant/lactating women: 4 small cans/week @140 g</p>

\*PTWI = Provisional Tolerable WEEKLY Intake. Note: JECFA and COT state advisories as PTWI (TDI X 7).

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**Status:** Policy statements (resolutions, position papers and motions) are categorized as:

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1. The activities outlined in the policy statement's implementation plan have not yet been completed; or
2. The policy statement addresses an issue that is currently relevant to public health in Ontario.

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