ATTACHMENT 1

FDA- EPA ADVISORY ("ONLINE ADVISORY")

http://www.fda.gov/Food/ResourcesForYou/Consumers/ucm110591.htm

What You Need to Know About Mercury in Fish and Shellfish (Brochure)

March 2004 EPA-823-R-04-005

(This document is also available in PDF (228 KB) and en Español (Spanish))

Advice for
Women Who Might Become Pregnant
Women Who are Pregnant
Nursing Mothers
Young Children

from the
U.S. Food and Drug Administration
U.S. Environmental Protection Agency

The Facts

Fish and shellfish are an important part of a healthy diet. Fish and shellfish contain high-quality protein and other essential nutrients, are low in saturated fat, and contain omega-3 fatty acids. A well-balanced diet that includes a variety of fish and shellfish can contribute to heart health and children's proper growth and development. So, women and young children in particular should include fish or shellfish in their diets due to the many nutritional benefits.

However, nearly all fish and shellfish contain traces of mercury. For most people, the risk from mercury by eating fish and shellfish is not a health concern. Yet, some fish and shellfish contain higher levels of mercury that may harm an unborn baby or young child's developing nervous system. The risks from mercury in fish and shellfish depend on the amount of fish and shellfish eaten and the levels of mercury in the fish and shellfish. Therefore, the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) are advising women who may become pregnant, pregnant women, nursing mothers, and young children to avoid some types of fish and eat fish and shellfish that are lower in mercury.

3 Safety Tips

By following these 3 recommendations for selecting and eating fish or shellfish, women and young children will receive the benefits of eating fish and shellfish and be confident that they have reduced their exposure to the harmful effects of mercury.

1. **Do not eat**
   - **Shark**
   - **Swordfish**
   - **King Mackerel**
   - **Tilefish**

   They contain high levels of mercury.

2. **Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are lower in mercury.**
   - Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish.
   - Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna. So, when choosing your two meals of fish and shellfish, you may eat up to 6 ounces (one average meal) of albacore tuna per week.
3. **Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas.**

   If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters, but don't consume any other fish during that week.

Follow these same recommendations when feeding fish and shellfish to your young child, but serve smaller portions.

Frequently Asked Questions *about Mercury in Fish and Shellfish*:

Note:
If you have questions or think you've been exposed to large amounts of methylmercury, see your doctor or health care provider immediately.

1. **What is mercury and methylmercury?**
   Mercury occurs naturally in the environment and can also be released into the air through industrial pollution. Mercury falls from the air and can accumulate in streams and oceans and is turned into methylmercury in the water. It is this type of mercury that can be harmful to your unborn baby and young child. Fish absorb the methylmercury as they feed in these waters and so it builds up in them. It builds up more in some types of fish and shellfish than others, depending on what the fish eat, which is why the levels vary.
2. **I'm a woman who could have children but I'm not pregnant - so why should I be concerned about methylmercury?**
   If you regularly eat types of fish that are high in methylmercury, it can accumulate in your blood stream over time. Methylmercury is removed from the body naturally, but it may take over a year for the levels to drop significantly. Thus, it may be present in a woman even before she becomes pregnant. This is the reason why women who are trying to become pregnant should also avoid eating certain types of fish.
3. **Is there methylmercury in all fish and shellfish?**
   Nearly all fish and shellfish contain traces of methylmercury. However, larger fish that have lived longer have the highest levels of methylmercury because they've had more time to accumulate it. These large fish (swordfish, shark, king mackerel and tilefish) pose the greatest risk. Other types of fish and shellfish may be eaten in the amounts recommended by FDA and EPA.
4. **I don't see the fish I eat in the advisory. What should I do?**
   If you want more information about the levels in the various types of fish you eat, see the FDA food safety website or the EPA website at www.epa.gov/ost/fish.
5. **What about fish sticks and fast food sandwiches?**
   Fish sticks and "fast-food" sandwiches are commonly made from fish that are low in mercury.

6. **The advice about canned tuna is in the advisory, but what's the advice about tuna steaks?**
   Because tuna steak generally contains higher levels of mercury than canned light tuna, when choosing your two meals of fish and shellfish, you may eat up to 6 ounces (one average meal) of tuna steak per week.
7. **What if I eat more than the recommended amount of fish and shellfish in a week?**
   One week's consumption of fish does not change the level of methylmercury in the body much at all. If you eat a lot of fish one week, you can cut back for the next week or two. Just make sure you average the recommended amount per week.
8. **Where do I get information about the safety of fish caught recreationally by family or friends?**
   Before you go fishing, check your Fishing Regulations Booklet for information about recreationally caught fish. You can also contact your local health department for information about local advisories. You need to check local advisories because some kinds of fish and shellfish caught in your local waters may have higher or much lower than average levels of mercury. This depends on the levels of mercury in the water in which the fish are caught. Those fish with much lower levels may be eaten more frequently and in larger amounts.

For further information about the risks of mercury in fish and shellfish call the U.S. Food and Drug Administration's food information line toll-free at 1-888-SAFEFOOD or visit FDA's Food Safety website.

For further information about the safety of locally caught fish and shellfish, visit the Environmental Protection Agency's Fish Advisory website or contact your State or Local Health Department. A list of state or local health department contacts is available. Click on Federal, State, and Tribal Contacts. For information on EPA's actions to control mercury, visit EPA's mercury website.

ATTACHMENT 2

EPA CONSUMPTION RECOMMENDATIONS BY PPM LEVEL

http://www.epa.gov/fishadvisories/advice/1-meal-per-week.pdf

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
WATER

TECHNICAL MEMORANDUM

DATE: March 11, 2004
RE: Origin of 1 Meal/Week Noncommercial Fish Consumption Rate in National

Advisory for Mercury

Background
The national advisory states that, for noncommercial fish, consumers should first consult any local advisories that may pertain to their catch. In case of no local advisory, consumers are advised to restrict consumption to 1 meal/week. Because states and tribes have not monitored nor posted advisories on all waters in the U.S., the noncommercial fish consumption advice is provided as a baseline of protection. This technical memorandum provides the methodology from which the default safe consumption rate is derived.

Introduction
Statistics on mercury concentrations in noncommercial fish were calculated from a national database. Mean fishtissue concentrations were compared against default fish consumption limits for mercury, as presented in EPAguidance. Noncommercial fish can be consumed at a rate of one 6-oz. meal of fish per week for the vast majority ofspecies.

Fish Tissue Database
Database: National Listing of Fish and Wildlife Advisories (NLFWA), US EPA, 2003.
Date range: All dates covering a range of years from 1987 to 2003.
Species selected: All species with data from at least 100 sampling stations in the database.
Sample type: Fillet only. Whole fish samples not included, as these are relevant for ecological risk.
Additional Notes: The NLFWA fish tissue database is data voluntarily provided to EPA, representing sampling and analysis performed by States and Tribes for the purpose of fish consumption advisory assessments. Thus the data collection is targeted to those areas of concern for increased fish contaminant levels. All fish data are from adult fish. Juveniles and fish organs are not included in the database as such data are relevant for ecological risk assessments, rather than human health risk assessments.

Fish Tissue Statistics
Statistics for each species are provided in Table 1. All of the statistics calculated for Table 1 are based on sampling station averages (means). That is, the mean value was calculated at each sampling station for each species. The statistics shown in Table 1 (count, mean, median, minimum, and maximum), then are calculated based on the station level averages. While some stations had as few as a single sample per species, others might have hundreds of samples. Thus, using station-level averages eliminates biasing toward stations with a large number of samples, and produces statistics that are more representative of the

entire population of sampling stations. From Table 1, one can see that species means range from 0.06 ppm to 0.96 ppm, but that the bulk of the species (27 out of 34) have average mercury concentrations between 0.13 ppm and 0.43 ppm.

Risk Based Fish Consumption Limits
US EPA, 2000, Table 4-3 (see attachment) presents risk-based fish consumption limits which relate the number of fish meals that can be eaten per month to fish tissue concentrations of methylmercury. The inputs used in the development of Table 4-3, are described in Section 3.3 of the same document (US EPA, 2000). These include:
Reference Dose (RfD): $1x10^{-4}$ mg/kg-d.
Meal Size: 8 oz., uncooked corresponding with 6 oz. cooked as used in the national advisory.
Body Weight: 70 kg, average body weight of adult males and females combined, in the U.S. population.

Derivation of Safe Fish Consumption Rate
US EPA, 2000, Table 4-3 (see attachment) presents safe fish consumption rates corresponding to various ranges of mercury contaminant concentrations. While Table 4-3 is quite detailed, most states have issued fish consumption advisories according to a more coarse consumption rate categorization, i.e.: no consumption, 1 meal/month, 1 meal/week, and 2 meals/week. At this categorization, states typically collapse the 2-4 meals/month consumption rates to a single 1 meal/week category. That is, by Table 4-3 (US EPA, 2000), one can safely consume 2 meals/week at concentrations ranging from >0.078 ppm to 0.12 ppm, and should consume no more than 1 meal/month at concentrations ranging from >0.47 ppm to 0.94 ppm. As can been seen from Table 1, below, the vast majority of fish species with contamination data (27 out of 34 species) have concentrations within the coarse 1 meal/week range (i.e. 2-4 meals/month range or > 0.12 ppm - 0.47 ppm). Thus, the general consumer should be advised to eat no more than 1 meal/week of noncommercial fish in the U.S. *Note:* Collapsing the 2-4 meal/month consumption rate to a 1 meal/week consumption rate strikes a balance between a too detailed advisory that would overwhelm or confuse most consumers, and simplified advice that balances risks from mercury with the benefits of fish. Consumers are encouraged to use more detailed information where available for the waterbodies on which they fish, and the fish species they choose to consume. Also, as can be seen from the minimum and maximum values in Table 1, mercury concentrations in fish vary considerably from waterbody to waterbody and region to region. Consumers should, first and foremost, consider any local advisories.

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Note: Collapsing the 2-4 meal/month consumption rate to a 1 meal/week consumption rate strikes a balance between a too detailed advisory that would overwhelm or confuse most consumers, and simplified advice that balances risks from mercury with the benefits of fish. Consumers are encouraged to use more detailed information where available for the waterbodies on which they fish, and the fish species they choose to consume. Also, as can be seen from the minimum and maximum values in Table 1, mercury concentrations in fish vary considerably from waterbody to waterbody and region to region. Consumers should, first and foremost, consider any local advisories.

Table 1. Mercury Contamination Statistics by Species* [NONCOMMERCIAL]

Species	# Stations	Concentration Statistics (ppm) Mean	Median	Minimum	Maximum
Bowfin	358	0.96	0.82	0.02	4.80
Chain pickerel	250	0.61	0.54	0.05	2.25
Largemouth bass	2,425	0.43	0.34	0.00	4.47
Walleye	1,520	0.40	0.34	0.02	3.30
Warmouth sunfish	147	0.39	0.34	0.02	1.36
Flathead catfish	158	0.37	0.21	0.02	2.31
Spotted bass	163	0.36	0.28	0.02	1.72
Northern pike	1,322	0.35	0.30	0.01	1.78
Lake trout	160	0.30	0.25	0.05	1.70
Sauger	109	0.28	0.18	0.03	1.40
Smallmouth bass	738	0.27	0.22	0.01	2.50
Yellow bullhead	185	0.27	0.18	0.00	1.38
Striped bass	146	0.27	0.25	0.01	1.05
Redear sunfish	215	0.26	0.21	0.01	1.58
Yellow perch	604	0.22	0.17	0.01	1.55
White perch	133	0.22	0.15	0.01	1.05
Freshwater drum	226	0.22	0.16	0.01	1.91
White bass	212	0.21	0.14	0.01	1.30
White crappie	352	0.19	0.11	0.01	1.70
Black crappie	652	0.19	0.14	0.00	1.50
Rock bass	376	0.19	0.17	0.01	0.69
Channel catfish	1,213	0.18	0.12	0.00	7.00
Rainbow smelt	116	0.18	0.14	0.02	0.67
Brown trout	131	0.16	0.12	0.01	1.25
Bluegill sunfish	1,062	0.15	0.10	0.01	4.49
Carp	426	0.14	0.10	0.01	1.84
Common carp	737	0.14	0.12	0.00	1.80
Pumpkinseed sunfish	107	0.13	0.09	0.01	1.02
Brown bullhead	214	0.13	0.08	0.01	2.46
White sucker	714	0.11	0.09	0.01	0.68
Rainbow trout	119	0.11	0.10	0.01	0.51
Black bullhead	130	0.10	0.07	0.01	0.68
Gizzard shad	151	0.09	0.10	0.01	0.40
English sole	241	0.06	0.06	0.02	0.13

* Data source: U.S. EPA NLFWA fish tissue database. October 2003.
Concentration statistics based on sampling station averages.
Shading indicates safe consumption rate associated with mean conc.:
1 meal/mo. 2 meal/mo. 3 meal/mo. 4 meal/mo. 8 meal/mo. 12 meal/mo.

References

US EPA, 2000. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: RiskAssessment and Fish Consumption Limits, Third Edition*, Office of Water, November 2000, EPA-823-B-00-008.

US EPA, 2003. National Listing of Fish and Wildlife Advisories (NLFWA): Fish Tissue Database. Data export October 2003. Available at: http://www.epa.gov/ost/fish/.

Table 4-3. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Methylmercury

Risk Based Consumption Limit[a]	Noncancer Health Endpoints[b]
Fish Meals/Month	Fish Tissue Concentrations (*ppm, wet weight*)
Unrestricted (>16)	0 - 0.029
16	>0.029 - 0.059
12	>0.059 - 0.078
8	>0.078 - 0.12
4	>0.12 - 0.23
3	>0.23 - 0.31
2	>0.31 - 0.47
1	>0.47 - 0.94
0.5	>0.94 - 1.9
None (<0.5)	>1.9

[a] The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.
[b] Chronic, systemic effects.

Notes:
1. Consumption limits are based on an adult body weight of 70 kg and an interim RfD of $1x10^{-4}$ mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for methylmercury is 1×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

ATTACHMENT 3

EPA, HEALTH EFFECTS

http://www.epa.gov/mercury/effects.htm#meth

Mercury

Health Effects

People in the U.S. are mainly exposed to methylmercury, an organic compound, when they eat fish and shellfish that contain methylmercury. Whether an exposure to the various forms of mercury will harm a person's health depends on a number of factors (below). Almost all people have at least trace amounts of methylmercury in their tissues, reflecting methylmercury's widespread presence in the environment and people's exposure through the consumption of fish and shellfish. People may be exposed to mercury in any of its forms under different circumstances. The factors that determine how severe the health effects are from mercury exposure include these:

- the chemical form of mercury;
- the dose;
- the age of the person exposed (the fetus is the most susceptible);
- the duration of exposure;
- the route of exposure -- inhalation, ingestion, dermal contact, etc.; and
- the health of the person exposed.

Mercury exists in three chemical forms. They each have specific effects on human health.

- Methylmercury
- Elemental mercury
- Other mercury compounds (inorganic and organic)

Methylmercury effects

For fetuses, infants, and children, the primary health effect of methylmercury is impaired neurological development. Methylmercury exposure in the womb, which can result from a mother's consumption of fish and shellfish that contain methylmercury, can adversely affect a baby's growing brain and nervous system. Impacts on cognitive thinking, memory, attention, language, and fine motor and visual spatial skills have been seen in children exposed to methylmercury in the womb. Recent human biological monitoring by the Centers for Disease Control and Prevention in 1999 and 2000 (PDF) (3 pp., 42 KB,

About PDF) shows that most people have blood mercury levels below a level associated with possible health effects. More recent data from the CDC support this general finding.

Outbreaks of methylmercury poisonings have made it clear that adults, children, and developing fetuses are at risk from ingestion exposure to methylmercury. During these poisoning outbreaks some mothers with no symptoms of nervous system damage gave birth to infants with severe disabilities, it became clear that the developing nervous system of the fetus may be more vulnerable to methylmercury than is the adult nervous system.

For more information on fish consumption advisories across the country, visit EPA's fish consumption web pages.

In addition to the subtle impairments noted above, symptoms of methylmercury poisoning may include; impairment of the peripheral vision; disturbances in sensations ("pins and needles" feelings, usually in the hands, feet, and around the mouth); lack of coordination of movements; impairment of speech, hearing, walking; and muscle weakness. People concerned about their exposure to methylmercury should consult their physician.

Mercury and Cancer. No human data indicate that exposure to any form of mercury causes cancer, but the human data currently available are very limited. Mercuric chloride has caused increases in several types of tumors in rats and mice, and methylmercury has caused kidney tumors in male mice. Scientists only observed these health effects at extremely high doses, above levels that produced other effects. When EPA revised its Cancer Guidelines in 2005, the Agency concluded that neither inorganic mercury nor methylmercury from environmental exposures are likely to cause cancer in humans. More technical information is available in volume V of the 1997 Mercury Study Report to Congress (PDF) (349 pp., 1.2 MB, about PDF) (see especially pages 47, 80, 107, and 161 of the file).

Additional Information:

Additional information on the health effects of methylmercury is available from the IRIS database at http://www.epa.gov/iris/subst/0073.htm and EPA's Methylmercury Water Quality Criterion Web site at http://www.epa.gov/waterscience/criteria/methylmercury/index.html. You can also visit the Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profile for mercury.

ATTACHMENT 4

FDA FISH DATA

http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/Seafood/FoodbornePathogensContaminants/Methylmercury/ucm115644.htm

Mercury Levels in Commercial Fish and Shellfish

Return to Advisory on Mercury in Seafood

See also Mercury Concentrations in Fish: FDA Monitoring Program

Table 1. Fish and Shellfish With Highest Levels of Mercury

SPECIES	MERCURY CONCENTRATION (PPM)					NO. OF SAMPLES	SOURCE OF DATA
	MEAN	MEDIAN	STDEV	MIN	MAX		
MACKEREL KING	0.730	N/A	N/A	0.230	1.670	213	GULF OF MEXICO REPORT 2000
SHARK	0.988	0.830	0.631	ND	4.540	351	FDA 1990-02
SWORDFISH	0.976	0.860	0.510	ND	3.220	618	FDA 1990-04
TILEFISH (Gulf of Mexico)	1.450	N/A	N/A	0.650	3.730	60	NMFS REPORT 1978

Table 2. Fish and Shellfish With Lower Levels of Mercury†

SPECIES	MERCURY CONCENTRATION (PPM)					NO. OF SAMPLES	SOURCE OF DATA
	MEAN	MEDIAN	STDEV	MIN	MAX		
ANCHOVIES	0.043	N/A	N/A	ND	0.340	40	NMFS REPORT 1978
BUTTERFISH	0.058	N/A	N/A	ND	0.360	89	NMFS

Table 2. Fish and Shellfish With Lower Levels of Mercury†							
SPECIES	MERCURY CONCENTRATION (PPM)					NO. OF SAMPLES	SOURCE OF DATA
	MEAN	MEDIAN	STDEV	MIN	MAX		
							REPORT 1978
CATFISH	0.049	ND	0.084	ND	0.314	23	FDA 1990-04
CLAM *	ND	ND	ND	ND	ND	6	FDA 1990-02
COD	0.095	0.087	0.080	ND	0.420	39	FDA 1990-04
CRAB [1]	0.060	0.030	0.112	ND	0.610	63	FDA 1990-04
CRAWFISH	0.033	0.035	0.012	ND	0.051	44	FDA 2002-04
CROAKER ATLANTIC (Atlantic)	0.072	0.073	0.036	0.013	0.148	35	FDA 1990-03
FLATFISH [2]*	0.045	0.035	0.049	ND	0.180	23	FDA 1990-04
HADDOCK (Atlantic)	0.031	0.041	0.021	ND	0.041	4	FDA 1990-02
HAKE	0.014	ND	0.021	ND	0.048	9	FDA 1990-02
HERRING	0.044	N/A	N/A	ND	0.135	38	NMFS REPORT 1978
JACKSMELT	0.108	0.060	0.115	0.040	0.500	16	FDA 1990-02
LOBSTER (Spiny)	0.09	0.14	‡	ND	0.27	9	FDA SURVEY 1990-02
MACKEREL ATLANTIC (N.Atlantic)	0.050	N/A	N/A	0.020	0.160	80	NMFS REPORT 1978
MACKEREL CHUB (Pacific)	0.088	N/A	N/A	0.030	0.190	30	NMFS REPORT 1978
MULLET	0.046	N/A	N/A	ND	0.130	191	NMFS REPORT

Table 2. Fish and Shellfish With Lower Levels of Mercury†							
SPECIES	MERCURY CONCENTRATION (PPM)					NO. OF SAMPLES	SOURCE OF DATA
	MEAN	MEDIAN	STDEV	MIN	MAX		
							1978
OYSTER	0.013	ND	0.042	ND	0.250	38	FDA 1990-04
PERCH OCEAN *	ND	ND	ND	ND	0.030	6	FDA 1990-02
POLLOCK	0.041	ND	0.106	ND	0.780	62	FDA 1990-04
SALMON (CANNED) *	ND	ND	ND	ND	ND	23	FDA 1990-02
SALMON (FRESH/FROZEN) *	0.014	ND	0.041	ND	0.190	34	FDA 1990-02
SARDINE	0.016	0.013	0.007	0.004	0.035	29	FDA 2002-04
SCALLOP	0.050	N/A	N/A	ND	0.220	66	NMFS REPORT 1978
SHAD AMERICAN	0.065	N/A	N/A	ND	0.220	59	NMFS REPORT 1978
SHRIMP *	ND	ND	ND	ND	0.050	24	FDA 1990-02
SQUID	0.070	N/A	N/A	ND	0.400	200	NMFS REPORT 1978
TILAPIA *	0.010	ND	0.023	ND	0.070	9	FDA 1990-02
TROUT (FRESHWATER)	0.072	0.025	0.143	ND	0.678	34	FDA 2002-04
TUNA (CANNED, LIGHT)	0.118	0.075	0.119	ND	0.852	347	FDA 2002-04
WHITEFISH	0.069	0.054	0.067	ND	0.310	28	FDA 2002-04
WHITING	ND	ND	‡	ND	ND	2	FDA SURVEY 1990-02

Table 3. Mercury Levels of Other Fish and Shellfish†							
SPECIES	MERCURY CONCENTRATION (PPM)					NO. OF SAMPLES	SOURCE OF DATA
	MEAN	MEDIAN	STDEV	MIN	MAX		
BASS (SALTWATER, BLACK, STRIPED)[3]	0.219	0.130	0.227	ND	0.960	47	FDA 1990-04
BASS CHILEAN	0.386	0.303	0.364	0.085	2.180	40	FDA 1990-04
BLUEFISH	0.337	0.303	0.127	0.139	0.634	52	FDA 2002-04
BUFFALOFISH	0.19	0.14	‡	0.05	0.43	4	FDA SURVEY 1990-02
CARP	0.14	0.14	‡	0.01	0.27	2	FDA SURVEY 1990-02
CROAKER WHITE (Pacific)	0.287	0.280	0.069	0.180	0.410	15	FDA 1990-03
GROUPER (ALL SPECIES)	0.465	0.410	0.293	0.053	1.205	43	FDA 2002-04
HALIBUT	0.252	0.200	0.233	ND	1.520	46	FDA 1990-04
LOBSTER (NORTHERN/AMERICAN)	0.310	N/A	N/A	0.050	1.310	88	NMFS REPORT 1978
LOBSTER (Species Unknown)	0.169	0.182	0.089	ND	0.309	16	FDA 1991-2004
MACKEREL SPANISH (Gulf of Mexico)	0.454	N/A	N/A	0.070	1.560	66	NMFS REPORT 1978
MACKEREL SPANISH (S. Atlantic)	0.182	N/A	N/A	0.050	0.730	43	NMFS REPORT 1978
MARLIN *	0.485	0.390	0.237	0.100	0.920	16	FDA 1990-02
MONKFISH	0.180	N/A	N/A	0.020	1.020	81	NMFS REPORT 1978

Table 3. Mercury Levels of Other Fish and Shellfish†							
SPECIES	MERCURY CONCENTRATION (PPM)					NO. OF SAMPLES	SOURCE OF DATA
	MEAN	MEDIAN	STDEV	MIN	MAX		
ORANGE ROUGHY	0.554	0.563	0.148	0.296	0.855	49	FDA 1990-04
PERCH (Freshwater)	0.14	0.15	‡	ND	0.31	5	FDA SURVEY 1990-02
SABLEFISH	0.220	N/A	N/A	ND	0.700	102	NMFS REPORT 1978
SCORPIONFISH	0.286	N/A	N/A	0.020	1.345	78	NMFS REPORT 1978
SHEEPSHEAD	0.128	N/A	N/A	0.020	0.625	59	NMFS REPORT 1978
SKATE	0.137	N/A	N/A	0.040	0.360	56	NMFS REPORT 1978
SNAPPER	0.189	0.114	0.274	ND	1.366	43	FDA 2002-04
TILEFISH (Atlantic)	0.144	0.099	0.122	0.042	0.533	32	FDA 2002-04
TUNA (CANNED, ALBACORE)	0.353	0.339	0.126	ND	0.853	399	FDA 2002-04
TUNA(FRESH/FROZEN, ALL)	0.383	0.322	0.269	ND	1.300	228	FDA 2002-04
TUNA (FRESH/FROZEN, ALBACORE)	0.357	0.355	0.152	ND	0.820	26	FDA 2002-04
TUNA (FRESH/FROZEN, BIGEYE)	0.639	0.560	0.184	0.410	1.040	13	FDA 2002-04
TUNA (FRESH/FROZEN, SKIPJACK)	0.205	N/A	0.078	0.205	0.260	2	FDA 1993
TUNA (FRESH/FROZEN, YELLOWFIN)	0.325	0.270	0.220	ND	1.079	87	FDA 2002-04
TUNA (FRESH/FROZEN, Species Unknown)	0.414	0.339	0.316	ND	1.300	100	FDA 1991-2004
WEAKFISH (SEA TROUT)	0.256	0.168	0.226	ND	0.744	39	FDA

Table 3. Mercury Levels of Other Fish and Shellfish†							
SPECIES	MERCURY CONCENTRATION (PPM)					NO. OF SAMPLES	SOURCE OF DATA
	MEAN	MEDIAN	STDEV	MIN	MAX		
							2002-04

Source of data: FDA 1990-2004, "National Marine Fisheries Service Survey of Trace Elements in the Fishery Resource" Report 1978,
"The Occurrence of Mercury in the Fishery Resources of the Gulf of Mexico" Report 2000

Mercury was measured as Total Mercury except for species (*) when only Methylmercury was analyzed.

ND - mercury concentration below detection level (Level of Detection (LOD)=0.01ppm)
N/A - data not available

†The following species have been removed from the tables:

- Bass (freshwater) – not commercial
- Pickerel – not commercial

‡ Standard deviation data generated for new data 2004 or later only.

[1]Includes: Blue, King, Snow
[2]Includes: Flounder, Plaice, Sole
[3]Includes: Sea bass/ Striped Bass/ Rockfish

NOTE: On February 8, 2006, technical changes were made to the data that was posted on January 19, 2006. The changes corrected data or more properly characterized the species of fish or shellfish sampled.

ATTACHMENT 5:

CDC NHANES DATA ON MERCURY LEVELS EXCEEDING EPA RfD

found at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5343a5.htm

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Blood Mercury Levels in Young Children and Childbearing-Aged Women --- United States, 1999--2002

Exposure to high levels of mercury (Hg) can cause neurologic and kidney disorders (*1--3*). Because methylated Hg (methyl-Hg) in the aquatic environment accumulates in animal tissues up the food chain, persons in the United States can be exposed by eating freshwater fish, seafood, and shellfish. Exposure of childbearing-aged women is of particular concern because of the potential adverse neurologic effects of Hg in fetuses. To determine levels of total blood Hg in childbearing-aged women and in children aged 1--5 years in the United States, CDC's National Health and Nutrition Examination Survey (NHANES) began measuring blood Hg levels in these populations in 1999. This report summarizes NHANES results for 1999--2002 and updates previously published information (*4,5*). The findings confirmed that blood Hg levels in young children and women of childbearing age usually are below levels of concern. However, approximately 6% of childbearing-aged women had levels at or above a reference dose, an estimated level assumed to be without appreciable harm (≥5.8 μg/L). Women who are pregnant or who intend to become pregnant should follow federal and state advisories on consumption of fish.

NHANES is a continuous survey of the health and nutritional status of the civilian, noninstitutionalized U.S. population; data are released and reported in 2-year cycles (*6*). Each participant undergoes a household interview and a physical examination. During the physical examination, blood is collected by venipuncture from all persons aged ≥1 year. For this analysis, whole-blood specimens were analyzed for total and inorganic Hg for children aged 1--5 years and women aged 16--49 years by automated, cold-vapor atomic absorption spectrophotometry in CDC's inorganic toxicology laboratory. The analytic method detection limit was 0.14 μg/L (ppb) for total Hg and 0.4 μg/L (ppb) for inorganic Hg (*7*). Blood Hg levels less than the limit of detection were assigned a value equal to the detection limit divided by the square root of 2 for the calculation of geometric mean (GM) values.

During 1999--2002, the GMs of total blood Hg concentrations for all childbearing-aged women and for children aged 1--5 years were 0.92 μg/L and 0.33 μg/L, respectively; the 95th percentiles of blood Hg for women and children were 6.04 μg/L and 2.21 μg/L, respectively (Table 1). The percentage of all women aged 16--49 years with Hg levels ≥5.8 μg/L (the Environmental Protection Agency's [EPA] Reference Dose [RfD]) was 5.66%

(95% confidence interval [CI] = 4.04--7.95) (Table 2).

Among children aged 1--5 years, the estimated percentage who had blood Hg levels ≥5.8 μg/L during 1999--2002 could not be reported because the observed percentage was too low for the given sample size to calculate a statistically reliable national population estimate. Almost all inorganic blood Hg levels were undetectable, indicating that total blood Hg greater than or equal to the EPA RfD mostly reflected exposure to organic Hg (especially methyl-Hg).

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Editorial Note:

This report updates NHANES 1999--2000 estimates of blood Hg levels (*5*), the first nationally representative estimates of U.S. women's and children's exposures to Hg based on biologic measures. The findings indicate that blood Hg levels in young children and childbearing-aged women usually are below levels of concern.

Among childbearing-aged women, for the 4-year period 1999--2002, estimates of the GM of blood Hg and the proportion with levels ≥5.8 μg/L were lower than estimates for the 2-year period 1999--2000, reflecting apparent declines in these values for the 2-year period 2001--2002. However, when these differences were evaluated by comparing estimates for the two 2-year periods, the declines were not statistically significant: the GM of blood Hg for 2001--2002 was 0.83 μg/L (CI = 0.73--0.93), compared with 1.02 μg/L (CI = 0.80--1.24) for 1999--2000, and the percentage of women with blood Hg levels ≥5.8 μg/L was 3.9% in 2001--2002 (CI = 2.40--6.43), compared with 7.8% in 1999--2000 (CI = 4.70--12.83). At least 2 more years of data are needed to best determine whether Hg exposure has declined among women of childbearing age in the United States.

Although NHANES data are released and often analyzed as 2-year periods, the estimates of blood Hg levels for 1999--2002 are the most reliable estimates of current exposure. The 4-year period provides greater geographic coverage, and estimates and sample errors are more stable, thus reducing variability caused by differing exposures to Hg across survey site locations. Accordingly, the National Center for Health Statistics advises users of these data that the most reliable estimates of current exposure are obtained when the 1999--2002 data are analyzed together (*6*).

The EPA RfD is based on measures of Hg in cord blood and is a level assumed to be without appreciable harm. The RfD was determined by applying an uncertainty factor of 10 to a dose (58 μg/L) that was the lower 95% confidence limit of a dose associated with an increased proportion of abnormal scores on the Boston Naming Test for children exposed in utero (*2*). All women and children in the 1999--2002 NHANES survey period had blood Hg levels below 58 μg/L. The harm to a fetus from levels of exposure as measured by cord blood levels between 5.8 μg/L and 58 μg/L is uncertain.

The findings in this report are subject to at least two limitations. First, NHANES does not include an adequate sampling of women (e.g., sport fishers) who might eat large amounts of fish to characterize the distribution of total blood Hg in this group. Second, the ratio of Hg in cord to maternal blood (i.e., equivalent to NHANES measures) is uncertain (*2,8*). Therefore, NHANES values might not be directly comparable to the EPA RfD, which is based on cord blood Hg levels.

Fish are an important part of a diet, high in protein and nutrients and low in saturated fatty acids and cholesterol. The short-term strategy to reduce Hg exposure is to eat fish with low Hg levels and avoid or reduce consumption of fish with high Hg levels. Because exposure to methyl-Hg can harm fetuses, the Food and Drug Administration (FDA) advises that women who are or might become pregnant not eat shark, swordfish, king

mackerel, and tile fish (*9*). In addition, EPA and the Agency for Toxic Substances and Disease Registry have established daily consumption levels of Hg considered to be without harm (*1*). State-based fish advisories and bans identify fish species contaminated by Hg and their locations and provide safety advice (*10*). The NHANES program continues to collect Hg measurements in human tissue to monitor the effectiveness of efforts to reduce Hg exposure in the U.S. population.

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Table 1

TABLE 1. Geometric means (GMs) and selected percentiles of total blood mercury (Hg) concentrations (μg/L) for women aged 16–49 years and children aged 1–5 years, by selected variables — National Health and Nutrition Examination Survey, United States, 1999–2002

Variable	No.	GM	(95% CI*)	Selected percentile (95% CI) 5th	(95% CI)	10th	(95% CI)	25th	(95% CI)
Women									
Race/Ethnicity									
Mexican American	1,106	0.74	(0.64–0.84)	0.10	(0.08–0.15)	0.17	(0.12–0.23)	0.34	(0.27–0.45)
White, non-Hispanic	1,377	0.87	(0.76–0.99)	0.09	(0.08–0.10)	0.15	(0.13–0.18)	0.37	(0.34–0.45)
Black, non-Hispanic	794	1.18	(1.00–1.36)	0.17	(0.12–0.25)	0.30	(0.24–0.38)	0.60	(0.55–0.73)
Age group (yrs)									
16–29	2,004	0.68	(0.60–0.76)	0.08	(0.07–0.09)	0.11	(0.09–0.14)	0.29	(0.25–0.37)
30–49	1,633	1.10	(0.97–1.24)	0.13	(0.10–0.16)	0.24	(0.20–0.29)	0.52	(0.45–0.60)
Pregnancy status									
Pregnant	629	0.75	(0.60–0.90)	0.08	(. . .†–0.10)	0.10	(0.08–0.20)	0.32	(0.24–0.44)
Not pregnant	2,978	0.94	(0.84–1.04)	0.10	(0.09–0.11)	0.18	(0.15–0.21)	0.41	(0.38–0.47)
Total	3,637	0.92	(0.82–1.02)	0.09	(0.09–0.11)	0.17	(0.15–0.20)	0.40	(0.36–0.47)
Children									
Race/Ethnicity									
Mexican American	526	0.35	(0.30–0.40)	. . .		0.08	(. . .–0.09)	0.13	(0.10–0.16)
White, non-Hispanic	447	0.29	(0.24–0.33)	. . .		0.07	(. . .–0.08)	0.09	(0.09–0.10)
Black, non-Hispanic	424	0.50	(0.44–0.57)	0.08	(. . .–0.10)	0.10	(0.09–0.13)	0.22	(0.18–0.26)
Total	1,577	0.33	(0.30–0.37)	. . .		0.07	(. . .–0.08)	0.10	(0.09–0.12)

* Confidence interval.
† Below the limits of detection.

TABLE 1. (*Continued*) Geometric means (GMs) and selected percentiles of total blood mercury (Hg) concentrations (μg/L) for women aged 16–49 years and children aged 1–5 years, by selected variables — National Health and Nutrition Examination Survey, United States, 1999–2002

Variable	Selected percentile (95% CI) 50th	(95% CI)	75th	(95% CI)	90th	(95% CI)	95th	(95% CI)
Women								
Race/Ethnicity								
Mexican American	0.73	(0.67–0.83)	1.27	(1.16–1.48)	2.38	(2.05–2.95)	3.60	(3.03–6.48)
White, non-Hispanic	0.81	(0.76–0.92)	1.69	(1.51–2.15)	3.73	(2.84–5.14)	6.17	(4.64–9.30)
Black, non-Hispanic	1.15	(1.05–1.41)	2.12	(1.86–2.70)	3.89	(3.24–5.03)	5.54	(4.27–11.08)
Age group (yrs)								
16–29	0.64	(0.55–0.77)	1.34	(1.24–1.54)	2.58	(2.28–3.13)	3.87	(3.32–7.80)
30–49	1.02	(0.91–1.19)	2.10	(1.79–2.69)	4.56	(3.74–5.76)	6.97	(5.73–11.62)
Pregnancy status								
Pregnant	0.73	(0.63–0.97)	1.50	(1.38–1.90)	3.11	(2.14–4.79)	4.86	(3.00–8.02)
Not pregnant	0.88	(0.80–1.00)	1.83	(1.65–2.11)	3.93	(3.26–4.93)	6.11	(5.12–10.90)
Total	0.86	(0.80–0.98)	1.81	(1.62–2.16)	3.89	(3.20–4.88)	6.04	(5.08–10.74)
Children								
Race/Ethnicity								
Mexican American	0.28	(0.24–0.33)	0.63	(0.56–0.81)	1.36	(1.05–1.57)	1.85	(1.60–2.66)
White, non-Hispanic	0.20	(0.17–0.25)	0.49	(0.38–0.63)	1.15	(0.80–1.49)	1.78	(1.18–2.69)
Black, non-Hispanic	0.47	(0.40–0.58)	0.88	(0.78–1.02)	1.54	(1.31–2.04)	2.37	(1.75–3.64)
Total	0.26	(0.23–0.29)	0.61	(0.56–0.70)	1.29	(1.08–1.69)	2.21	(1.80–3.66)

Return to top.

Table 2

TABLE 2. Percentage of women aged 16–49 years with blood mercury (Hg) levels ≥5.8 μg/L, by race/ethnicity — National Health and Nutrition Examination Survey, United States, 1999–2002

Race/Ethnicity	No.	% with Hg levels ≥5.8 μg/L	(95% CI*)
Mexican American	1,106	1.70	(1.04–2.79)
White, non-Hispanic	1,377	5.77	(3.71–8.97)
Black, non-Hispanic	794	4.82	(2.55–9.11)
Total	3,637	5.66	(4.04–7.95)

* Confidence interval.

ATTACHMENT 6

REVIEW OF RECENT SCIENTIFIC STUDIES

The US EPA established the US Reference Dose for methylmercury in 1999, based on the best evidence then available, using data from a long-term epidemiological study in the Faeroe Islands carried out by researchers at Harvard and elsewhere. Research since then has sharpened scientific understanding of the benefits of maternal fish consumption for prenatal cognitive development, of the harm done by methylmercury to that cognitive development, and of improved research designs for separating the two effects. Several recent studies suggest more strongly than ever that public health concern over methylmercury exposure is completely justified, and that the effort to guide women to pick low-mercury fish must be expanded and improved.

In 2007, the Faeroe Islands research team reanalyzed their data to adjust for maternal fish intake, and determined that after adjusting for nutritional effects of fish consumption, cognitive deficits attributed to methylmercury were actually about twice as large as had originally been reported.[1] Similarly, a research team doing another long-term study, in the Seychelles Islands, which had previously reported no significant adverse effects of methylmercury on cognitive development, did a new analysis focused on measuring benefits of maternal fish consumption. In 2008, for the first time, the Seychelles researchers reported observing adverse mercury effects, which they concluded were probably masked by beneficial effects in their earlier analyses.[2]

Two US studies have shown that developmental benefits of fish intake and adverse effects of methylmercury occur in babies whose mothers consume average American amounts of fish. A study in Boston[3] has assessed verbal development at the ages of six months and three years; high fish consumption during pregnancy improved scores, while higher mercury exposure (from the higher-mercury fish those women ate) reduced scores. The effects were of roughly comparable magnitude in the affected groups, about 5 points on a 100-point scale. A New York City study[4] tested children's cognitive development at the ages of 12, 24, 36 and 48 months, using standard tests, and found similar results: High fish consumption enhanced performance, while elevated mercury exposure decreased performance on the same tests.

The populations in the Faeroes and Seychelles have high-fish diets, and the Faroese in fact get most of their methylmercury exposure from pilot whale meat. But the women in the Boston and New York studies had ordinary levels of fish consumption and mercury exposure. Only 7 percent of the Boston women ate two or more fish meals per week; about 5 percent of US women eat fish that often, according to CDC. The Boston research team classified a child as having high prenatal mercury exposure if his mother's hair mercury value was above the 90th percentile, which was 1.2 ppm in the study population. The 90th percentile hair NHANES mercury level is 1.1 ppm. Oken et al. did not measure blood mercury, but NHANES regional data show that the 90th percentile blood mercury level for women in New England is 5.2 µg/l.[5] The New York study measured blood mercury, but not fish consumption. The geometric mean blood mercury level in the

women included in the study was 0.91 µg/l, while the geometric mean for the national NHANES sample was 0.92 µg/l.

Further research is needed to better document the complex relationships between fish intake during pregnancy and cognitive development. But the available evidence strongly suggests that methylmercury exposure can have adverse effects even at doses associated with just one or two fish meals per week. There is no evidence of a threshold for this toxic effect. Since women are advised to consume fish while pregnant, for the nutritional benefits, it seems vitally important that advice also be provided that helps women identify and buy low-mercury fish, so they (and their babies) can simultaneously enjoy the nutritional benefits and minimize their exposure to methylmercury.

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FISH ADVISORY
Women Under Age 45 and Children

Seafood contains important nutrients, including Omega-3 fatty acids, but also contains mercury, which can be harmful to women and children.

DO NOT EAT

Swordfish - Shark - Tilefish - King Mackerel

Limit albacore tuna to one, 6-ounce serving a week, and eat no other fish that week.

Light canned tuna, however, may be eaten twice a week.

High (avoid)	Moderate (limit to one, 6-oz serving/week)*	Lower (12-ounces or 2 servings per week) (listed from lowest to highest levels)		
Fresh/Frozen Tuna and Sushi Tuna	Snapper	Shrimp	Pollock	Atlantic Croaker
Spanish Mackerel	Skate	Sardines	Atl. Mackerel	Whitefish
Chilean Sea Bass	Freshwater Perch	Tilapia	Anchovy/Herring	Pac. Mackerel/Chub
Grouper	Monkfish	Clams, Oysters,	Sole, Flounder	Smelt
Marlin	Halibut	Scallops,Mussels	Crab	Cod
Orange Roughy	Sablefish	Salmon	Pike	Canned Light Tuna
	Sea Trout	Crayfish	Butterfish	Spiny Lobster
	Sea Bass	Freshw. Trout	Catfish	
	Bluefish	Ocean Perch/Mullet	Squid	
	American Lobster			

(1) * Women under age 45 and children who eat fish from the yellow category should eat no other fish that week.

(2) Fish are listed from lowest to highest mercury levels.

(3) For more information see www.epa.gov/mercury or www.fda.gov.