ConsumerReports®

FOOD SAFETY & SUSTAINABILITY CENTER

MERCURY IN FISH REPORT

Current Contributors to the Consumer Reports Food Safety and Sustainability Center

The following individuals are currently associated with Consumer Reports Food Safety and Sustainability Center. Highlights of their roles and expertise are provided below.

CR Scientists

Dr. Urvashi Rangan leads Consumer Reports' Consumer Safety and Sustainability Group and serves as the Executive Director of its Food Safety and Sustainability Center. Dr. Rangan directs all of the organization's food-safety testing and research in addition to the scientific risk assessments related to food and product safety, which she translates into actionable recommendations for lawmakers and consumers. She is an environmental health scientist and toxicologist and is a leading expert, watchdog, and spokesperson on food labeling and food safety. Dr. Rangan received her Ph.D. from the Johns Hopkins School of Public Health.

Charlotte Vallaeys is a senior policy analyst and writer for the Consumer Reports' Food Safety and Sustainability Center. She focuses on sustainability and justice in the food system and works on a variety of food policy and food safety issues, including food labeling and organic policy. She regularly attends National Organic Standards Board meetings as a watchdog for the organic label and has done work for the National Organic Coalition. She previously worked as Policy Director at The Cornucopia Institute. She received her master's degree in theological studies from Harvard University, where she studied social and environmental ethics, and a master's of science in nutrition from the Friedman School of Nutrition Science and Policy at Tufts University.

Dr. Doris Sullivan is the Associate Director for Product Safety in Consumer Reports' Consumer Safety and Sustainability Group. She oversees product safety testing, research, and prioritization. She is also an expert in compiling and analyzing large datasets. She received her Ph.D. in chemistry from Boston University and completed postdoctoral research at the Free University of Brussels and University of Pennsylvania.

Dr. Michael K. Hansen is a Senior Scientist with Consumers Union, the policy and advocacy arm of Consumer Reports. He works primarily on food safety issues, including pesticides, and has been largely responsible for developing the organization's positions on the safety, testing and labeling of genetically engineered food and mad cow disease. Dr. Hansen served on the Department of Agriculture's Advisory Committee on Agricultural Biotechnology from 1998 to 2002 and on the California Department of Food and Agriculture Food Biotechnology Advisory Committee from 2001 to 2002.

Dr. Keith Newsom-Stewart is a Statistical Program Leader at Consumer Reports. During his tenure, he has worked on a wide range of projects, including those related to meat, seafood, and poultry safety and food additives. He specializes in linear and nonlinear mixed models, experimental design, and analysis of complex surveys. Prior to coming to CR, he worked for the Cornell Biometrics Unit and College of Veterinary Medicine. His educational background is in statistics, general biology, and genetics. He is an adjunct math professor at Western Connecticut State University and a member of the American Statistical Association.

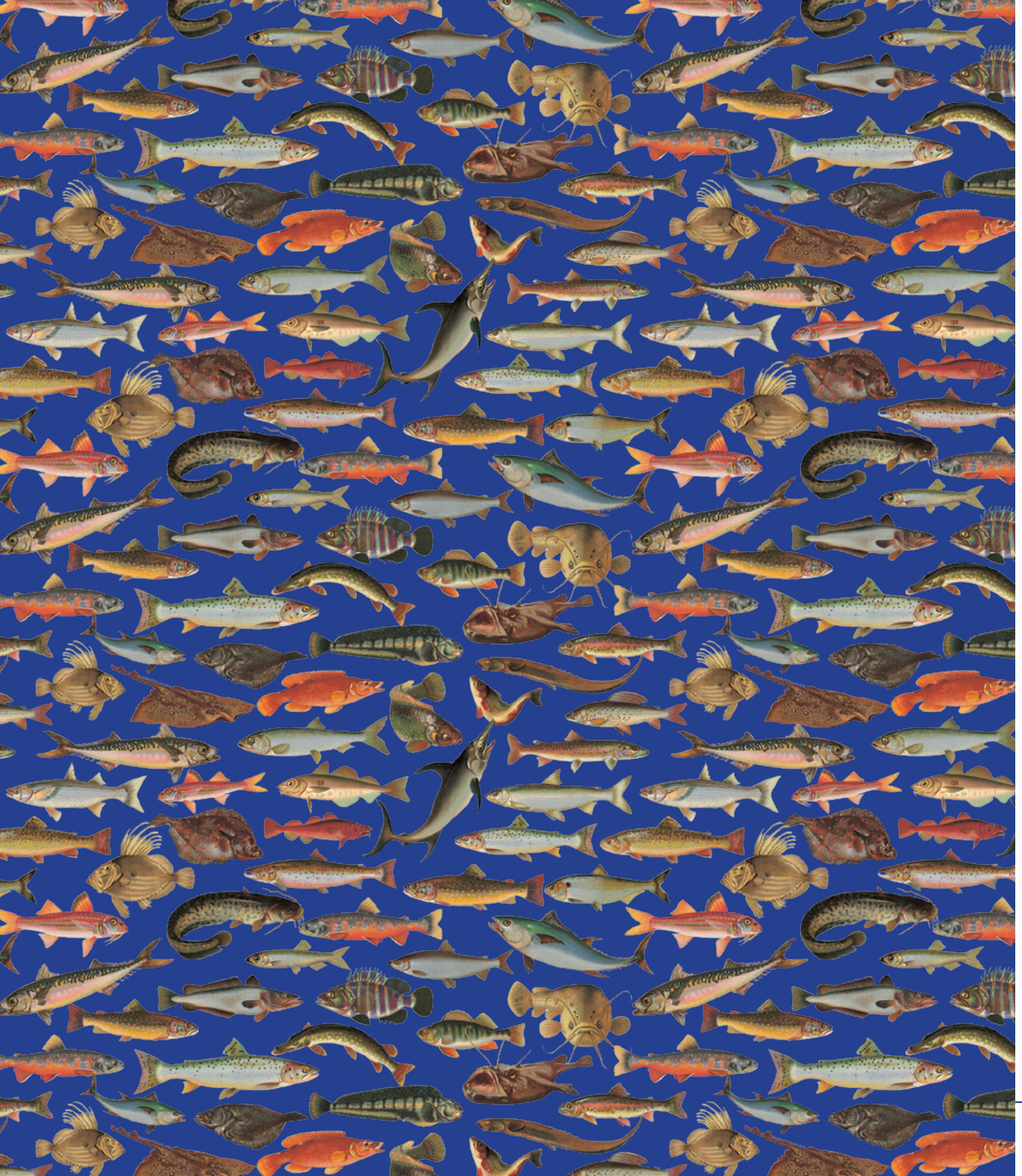
CR Communications

Jennifer Shecter is the Director of Content Impact & Corporate Outreach. In this capacity, she manages the center's partnerships and relationships, coordinates its overall public service activities, and pursues strategic initiatives to build support for its mission. She has been with Consumer Reports for more than a decade, serving first in its Communications Department, promoting food and product safety issues, then working as the Senior Adviser to the President—writing speeches, op-eds, and briefing materials—and advising on key organizational issues.

CR Advisers

Dr. Mary Sheehan is a consultant in environmental health. As Associate Faculty at the Johns Hopkins Bloomberg School of Public Health and the Pompeu Fabra University she also teaches and researches on policies to reduce health risks from global environmental pollutants such as methylmercury and from the impacts of a changing climate. In various positions at the World Bank her work focused on improving urban environmental infrastructure and policies in low- and middle-income countries. Dr. Sheehan received her Ph.D. in environmental risk management from the Johns Hopkins Bloomberg School of Public Health.

Chantelle Norton is an artist and designer and is a lead designer of Consumer Reports' Food Safety and Sustainability Center reports. She has worked in many fields of design, from fashion to print to costume to graphic design. She lives in the Lower Hudson Valley with a medley of animals, including her pet chickens. Her latest paintings take the chicken as muse and feature portraits of her feathered friends in landscapes inspired by the Hudson Valley and Ireland.



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Introduction

Almost all seafood contains mercury in varying amounts, and getting too much of it can damage the brain and nervous system. That is especially true for fetuses, but children and adults who eat too much high-mercury seafood can also suffer harmful effects.

In June 2014, the Food and Drug Administration (FDA) and Environmental Protection Agency (EPA) came out with proposed guidelines recommending that pregnant and breastfeeding women, women who might become pregnant, and young children eat more fish.

We are concerned that consumers who follow these latest government guidelines without careful attention to which species they are consuming could end up taking in too much mercury.

Using FDA data that measure mercury levels in various types of seafood, we developed three lists: "Lowest Mercury Fish," "Low Mercury Fish," and "Higher Mercury Fish." We identified almost 20 seafood choices that can be eaten several times per week, even by pregnant women and young children, without exceeding the reference dose set by the EPA. We also considered environmental and sustainability concerns and did not include on our recommended list types of fish that are low in mercury but caught or farmed in ways that can cause major environmental damage.

We also took a close look at tuna, which is one of the most popular seafood items in the U.S. Given its popularity and mercury content, canned tuna accounts for 28 percent of Americans' exposure to mercury, according to a 2007 analysis by an EPA researcher.

We disagree with the FDA and EPA on how much tuna women and children should eat. Given the potential harm to a fetus, we recommend that pregnant women and those thinking about becoming pregnant *should not eat any tuna* for the duration of their pregnancy.

Consumers can use our recommendations to choose seafood wisely. The choices on our "lowest mercury" and "low mercury" lists can be eaten several times per week without worrying about mercury exposure. And our chart on page 10 shows how much tuna a person can safely eat, based upon body weight.

Seafood and Safety — Why Our Choices Matter

MERCURY IN FISH — HEALTH EFFECTS

Varying amounts of mercury occur in almost all seafood, with some types containing more of the toxin than others. People are exposed to this toxin mostly through the consumption of fish and shellfish. When you eat seafood containing methylmercury (a form of mercury that builds up in fish and shellfish), more than 95 percent is absorbed, passing into your bloodstream. It can move throughout your body, where it can penetrate cells in any tissue or organ.

Consuming too much mercury can damage the brain and nervous system. This is of special concern during human development in the womb. Mercury crosses the placenta and concentrates in fetal tissues and can potentially damage the brain at a critical stage of development. "The brain undergoes a series of complex developmental stages that need to be completed in the right sequence and at the right time," explains Philippe Grandjean, M.D., an adjunct professor at the Harvard T.H. Chan School of Public Health and a leading researcher. A pregnant woman's intake of methylmercury from fish could reach the fetus within hours and could leave a permanent deficit at a critical time, he says.

Children and adults who eat too much high-mercury seafood can also suffer harmful effects. Studies have shown that mercury exposure in adults might lead to problems with fine motor coordination, speech, sleep, and walking.

Like many other environmental contaminants, mercury can accumulate in the body over time. A study of New York City adults found that nearly 25 percent had blood mercury concentrations at or above 5 micrograms per liter of blood. While the EPA considers 5.8 micrograms per liter to be the maximum acceptable level, we believe this to be too high. The guideline was set more than a decade ago, and several studies published since then show adverse effects can occur at lower blood mercury levels.

Deborah Rice, a former senior risk assessor for the EPA, thinks the limit should be lower. In 2001, Rice co-wrote the EPA document that established the current limit. "Based on newer studies showing harm from mercury at lower doses, there is no question that 5.8 micrograms is too high," she says. She suggests that the acceptable level should be reduced to 2 or 3 micrograms of mercury per liter of blood.

The New York City study also found that blood mercury levels in adults who reported consuming fish or shellfish very frequently were 3.7 times the levels in those who reported no fish or shellfish consumption.

HOW DOES MERCURY GET INTO FISH?

Mercury, like other heavy metals, occurs naturally in the environment, but humans have increased its presence in the atmosphere and oceans. Coal combustion, chlorine alkali processing, waste incineration, and metal processing are the primary sources from human activity. Best estimates to date suggest that human activity has about doubled or tripled the amount of mercury in the atmosphere, and the atmospheric burden is increasing by about 1.5 percent per year. Mercury gets into oceans and lakes from the atmosphere primarily through rainfall.

Mercury levels in the northern Pacific Ocean have risen about 30 percent over the past 20 years and are expected to increase by 50 percent more by 2050 as industrial emissions increase, according to a 2009 study led by researchers at the U.S. Geological Survey and Harvard University. And an analysis of mercury by researchers at the University of Michigan showed that concentrations of the toxin in Hawaiian yellowfin tuna remained steady between 1971 and 1998 but shot up at a rate of 3.8 percent per year between 1998 and 2008.

How does mercury end up in the fish we eat? The exact mechanism by which mercury enters the food chain is still largely unknown, but scientists do know that bacteria play an important role in converting inorganic mercury to the more toxic methylmercury. These bacteria may then release methylmercury to the water, where it adsorbs to plankton, an important food source for countless marine species. This plankton, as well as the methylmercury-containing bacteria, are consumed by tiny fish, which are in turn eaten by small fish, which are then gobbled up by larger fish, whose tissue accumulates mercury. That's why larger, longer-living predators such as sharks, swordfish, and many types of tuna tend to have more of the toxin than smaller fish such as sardines, sole, and trout.

Methodology

In order to develop our recommendations we analyzed the FDA database of mercury in fish posted in 2011. We used this data to create lists of the fish with lowest, low, and higher levels of mercury. We devised recommendations based on these lists to assure the safety of women of childbearing age and young children. We created two lists of low mercury fish: one of lowest mercury fish that can be consumed six times a week (6-ounce serving for adults; 3-ounces serving for children) and a second low-mercury group that can be eaten three times per week for adults and two times per week for children.

To develop our fish lists, we looked at the FDA database posted on its website, which indicates the number of samples it tested and the mean, minimum, and maximum mercury levels found in the species in parts per million and other information. We calculated the maximum amount of fish a person could eat without exceeding the EPA reference dose of 0.1 micrograms per kilogram of body weight per day. We made our calculations based on vulnerable consumers, which were considered a child of 20 kilograms (44 pounds of weight that approximates average 3- to 6-year-old children) and a woman of childbearing age at 60 kilograms (132 pounds, approximately the 25th percentile of women of childbearing age).

In order to make the "**Lowest** Mercury Fish" list, the data in the FDA data set for the species had to meet the following criteria:

1. At least 20 samples of the species
2. **Mean mercury concentration** was 0.027 ppm or lower.

At this level a 20 kilogram child could consume about 18 ounces of the fish per week and not exceed the EPA reference dose of 0.1 microgram per kilogram of body weight per day, and a 132 pound adult could consume at least 36 ounces.[1,2]

3. The **maximum mercury concentration** for any sample from the species was 0.25 ppm or less.

Species with levels above this concentration were excluded from the list even if the mean concentration was less than 0.027 ppm, because of the potential for consumers to encounter fish with these spiked levels.

At 0.25 ppm a 60 kilogram woman could exceed the EPA reference dose after eating only 6 ounces of the species per week.[3]

In order to make the "**Low** Mercury Fish" list, the data in the FDA data set for the species had to meet the following criteria:

1. At least 20 samples of the species
2. **Mean mercury concentration** was 0.082 ppm or lower.

At this level a 20 kilogram child could consume 6 ounces of the fish per week and not consume enough mercury to exceed the EPA reference dose of 0.1 microgram per kilogram of body weight per day, and a 132 pound adult could consume up to 18 ounces.[4,5]

3. The **maximum mercury concentration** for any sample from the species was 0.25 ppm or less.

Fish fell into the higher mercury category if they met the following criteria:

1. At least 15 samples of the species

AND

2. **Mean mercury concentration** was higher than 0.3 ppm.

At this level a 20 kilogram child would exceed the EPA reference dose by consuming only 1.6 ounces of the fish per week, and a 132 pound adult would exceed it after less than 5 ounces.[6]

OR

3. The **maximum mercury concentration** for any sample from the species was 1 ppm or greater in multiple non-consecutive years.

At 1 ppm a 132 pound woman could exceed the EPA reference dose after eating only 1.5 ounces of the species per week.[7]

Other Considerations That Can Impact Specific Recommendations

ENVIRONMENTAL CONSIDERATIONS

To ensure sure your fish consumption is not contributing to major environmental damage or endangering fish species, we have checked our list of recommended low mercury fish against the Monterey Bay Aquarium's national "avoid" list—one we consider to provide a high standard for fish and ocean conservation efforts. Most of the low mercury fish are not endangered nor otherwise pose environmental hazards, according to the aquarium. However there are some things to be concerned about. For example, the aquarium recommends that when buying squid (calamari), you purchase domestic fish, not imported. They also say to avoid haddock from the Gulf of Maine, although haddock from Georges Banks, Canada, and Iceland are good alternatives due to environmental issues. It is always a good idea to check their list when choosing the fish you eat: *seafoodwatch.org/seafood-recommendations/consumer-guides*

If we only considered mercury levels, shrimp would be a good choice. However there are many other factors that make it more tricky to recommend. The majority of shrimp in the U.S. are imported and produced in aquaculture systems that raise many environmental concerns. The Monterey Bay Aquarium recommends that you not purchase imported farmed shrimp or wild shrimp imported from Mexico.

Overall, we have not included fish on our recommended list that are low in mercury but cause major environmental damage. For this reason, we are recommending only U.S. farmed and most wild shrimp and only domestic squid and crawfish.

PCB CONSIDERATIONS

In addition to mercury levels, PCBs (polychlorinated biphenyls) are another contaminant of concern in fish. There is not a significant amount of reliable data available for fish that are commercially caught or farmed. As a result we were not able to take PCB levels into account when creating our lists, but we recommend that consumers check current advisories.

PCBs are man-made chemicals that were formerly used in many industries. Banned in 1979, these chemicals still persist in our environment and many products. PCBs can accumulate in fatty tissues, and levels are influenced by feed and habitat. Sport fish caught in lakes, rivers, reservoirs, and bays can sometimes have concerning levels of PCBs. Local health departments in many states monitor PCBs in fish and may issue advisories if they reach a level of concern. You can learn more about PCBs and advisories in your area from your state health department website (see here for a listing of websites: *fishadvisoryonline.epa.gov/Contacts.aspx*).

BACTERIA CONSIDERATIONS

Various bacteria that are found in fish can cause food-borne illness, some very serious, such as certain types of vibrio. Because these concerns tend to be episodic, we did not factor this concern into our recommendations. However, particularly when eating shellfish, we recommend that consumers follow local advisories about what is safe to eat. We also advise pregnant women and young children to avoid eating raw shellfish, due to bacterial risks.

The Recommendations

Our results here are directed primarily at women of childbearing age, children, or people who eat a lot of fish (a pound and a half a week or more[8]). We have created a list of "Lowest Mercury Fish" that people in this vulnerable group can eat without concern for mercury, while getting the health benefits of eating fish. We have also created a second list of "Low Mercury Fish" that can be eaten frequently—several times a week—by these groups. We have factored environmental and sustainability considerations into these recommended lists. We have provided links to local advisories for additional information about other contaminants. We have also created a list of "Highest Mercury Fish," which pregnant women, children, and people who eat fish regularly may wish to avoid or eat only occasionally. See lists in boxes below.

Fish and Shellfish in General

LOWEST Mercury Fish (Sustainable)

A 132 pound person can safely eat 36 ounces per week.
A 44 pound child can safely eat 18 ounces per week.

- **Wild & Alaska salmon—canned or fresh**
- **Shrimp—most wild and U.S. farmed**
- **Sardines**
- **Tilapia ***
- **Scallops ****
- **Oysters ****
- **Squid (calamari) *—domestic**

LOW Mercury Fish (Sustainable)

A 132 pound person can safely eat up to 18 ounces per week.
A 44 pound child can safely eat up to 6 ounces per week.

- **Haddock**
- **Pollock**
- **Flounder and sole (flatfish)**
- **Catfish * #**
- **Trout #**
- **Atlantic mackerel**
- **Atlantic croaker**
- **Mullet**
- **Crawfish—domestic**
- **Crab ****

**You may want to consider country of origin and choose domestic rather than imported if possible.*

*** Always follow any local alerts regarding when shellfish can be safely harvested and eaten. Eating shellfish raw always carries additional risks of food-borne illness and is not recommended for vulnerable groups.*

 # If wild caught (which includes being fished from local rivers and lakes), check with your state health department for information about PCBs especially for these fish, but it's a good idea to check for anything on the list if you are concerned about PCBs.

HIGHER Mercury Fish

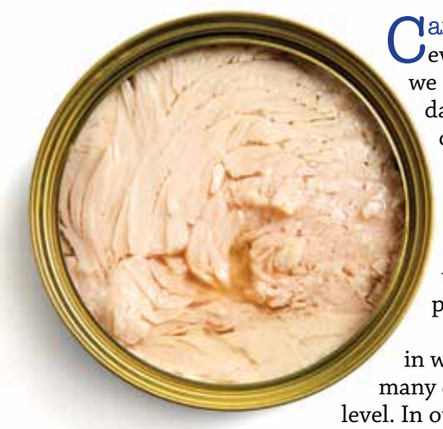
A 132 pound person would exceed the EPA's "safe" mercury consumption level eating just 6 ounces per week and for some of these fish even less than that. One six ounce meal weekly is just half the total fish consumption the USDA recommends. One should therefore eat these fish only very infrequently. The FDA advises women of childbearing age and young children not to eat the highest mercury fish, marked with an X below, at all. The FDA is considering adding two more to its "do not eat" list, marked with **.

- **Swordfish X**
- **Shark X**
- **King mackerel X**
- **Gulf tilefish X**
- **Marlin ****
- **Orange roughy ****
- **Grouper**
- **Chilean sea bass**
- **Bluefish**
- **Halibut**
- **Sablefish (Black cod)**
- **Spanish mackerel (Gulf)**
- **Tuna (except Skipjack and canned light)**

X The FDA says that women of childbearing age and young children should avoid these fish.

*** The FDA is considering advising women of childbearing age and young children to avoid these fish.*

Tuna



Canned tuna is one of the most popular seafood items in the U.S. However, as we discussed in Consumer Reports articles in 2006 and 2011, we do not recommend that pregnant women consume tuna. Newer FDA data only reinforce this advice. While the average level of methylmercury in canned albacore remained consistent throughout FDA's testing period from 1991 to 2010, the average level (mean) of methylmercury in canned chunk light tuna samples from 2005 to 2010 (compared to those previously reported by the FDA) rose from 0.118 to 0.139 ppm, thus changing our weekly consumption advice for chunk light tuna. See the tables below for how much albacore or chunk light canned tuna a person can eat according to their weight.

Chunk light contains, on average, about one third of the mercury found in white albacore. The problem, though, even with chunk light is that while many cans are quite low in mercury, certain samples test at a relatively high level. In our own 2011 tests, we found these spikes in 6 percent of samples. In the FDA's new database, some 20 percent of chunk-light samples have mercury levels above 0.25 ppm. *We therefore continue to recommend, more strongly than ever, that pregnant women and those who are thinking about becoming pregnant should not eat tuna for the duration of their pregnancy.* This is because consuming tuna might cause a spike in mercury that could affect a developing fetus at a critical point.

Our advice for all other consumers regarding tuna is to not exceed the amount recommended for your body weight, as noted in the table.

Recommendations (oz/week) for Canned Light and Albacore Tuna Consumption by Weight (lbs)																			
Body Weight lbs	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	187	198	209	220
Canned Light Oz/ Week	1.9	2.9	3.8	4.8	5.8	6.7	7.7	8.7	9.6	10.6	11.5	12.5	13.5	14.4	15.4	16.4	17.3	18.3	19.2
Albacore Oz/Week	0.7	1.1	1.4	1.8	2.1	2.5	2.8	3.2	3.5	3.9	4.2	4.6	4.9	5.3	5.6	6.0	6.3	6.7	7.0

Another question that arises is whether one can eat tuna sushi. Unfortunately for tuna lovers, the tuna in sushi is almost always a high mercury type. Several varieties often used—bigeye and bluefin—have average levels even higher than albacore. Indeed some tuna samples have levels comparable to that of shark and swordfish, which appears on the FDA's "do not eat" list for women of childbearing age.

We recommend that vulnerable populations—women of childbearing age, young children, and people who eat a lot of fish—avoid tuna sushi. Others may want to consume it only infrequently. Other types of sushi, such as salmon, can of course be eaten more frequently.

Endnotes

[1] 0.1 ug Hg/kg bw/day * 20 kg/bw *(1 mg Hg/1000 ug Hg) * (1 kg fish/0.027 mg Hg)*2.205 lb fish/kg fish * 16 oz fish / lb fish *7 days/week = 18.3 oz/week

[2] 0.1 ug Hg/kg bw/day * 60 kg/bw *(1 mg Hg/1000 ug Hg) * (1 kg fish/0.027 mg Hg)*2.205 lb fish/kg fish * 16 oz fish /lb fish *7 days/week = 55 oz/week

[3] 0.1 ug Hg/kg bw/day * 60 kg/bw *(1 mg Hg/1000 ug Hg) * (1 kg fish/0.25 mg Hg)*2.205 lb fish/kg fish * 16 oz fish /lb fish *7 days/week = 5.9 oz/week

[4] 0.1 ug Hg/kg bw/day * 20 kg/bw *(1 mg Hg/1000 ug Hg) * (1 kg fish/0.082 mg Hg)*2.205 lb fish/kg fish * 16 oz fish /lb fish *7 days/week = 6 oz/week

[5] 0.1 ug Hg/kg bw/day * 60 kg/bw *(1 mg Hg/1000 ug Hg) * (1 kg fish/0.082 mg Hg)*2.205 lb fish/kg fish * 16 oz fish /lb fish *7 days/week = 18 oz/week

[6] 0.1 ug Hg/kg bw/day * 60 kg/bw *(1 mg Hg/1000 ug Hg) * (1 kg fish/0.3 mg Hg)*2.205 lb fish/kg fish * 16 oz fish /lb fish *7 days/week = 4.9 oz/week

[7] 0.1 ug Hg/kg bw/day * 60 kg/bw *(1 mg Hg/1000 ug Hg) * (1 kg fish/1 mg Hg)*2.205 lb fish/kg fish * 16 oz fish /lb fish *7 days/week = 1.5 oz/week

[8] This is between the 95th and 99th percentile for those who weigh 70 kg and consume fish and shellfish.

About Consumer Reports' Food Work and Its Food Safety and Sustainability Center

Consumer Reports has been concerned about the quality and safety of the food supply since its earliest years. It did pioneering research on the presence of nuclear fallout in the American diet (Strontium-90) in the 1950s and 1960s, which helped build support for the Test Ban Treaty of 1963. The magazine's 1974 landmark series on water pollution played a role in the Safe Drinking Water Act. The organization has been testing meat and poultry for pathogens and antibiotic resistance for more than 15 years and has used its research to successfully fight for reforms such as the 2010 campylobacter standard for chicken and turkey, the 2011 Food Safety Modernization Act, and improvements to the salmonella standards.

In 2012, Consumer Reports launched its Food Safety and Sustainability Center to fight for sweeping, systemic change and address the root causes of problems plaguing the food system. The Center's work focuses on issues including foodborne illness and antibiotic resistance; pesticide use; heavy metals (mercury, lead, arsenic); truth and transparency in labeling; and promoting more sustainable agricultural practices that advance the marketplace, such as animal welfare, organic farming, and fair trade. At the core of the Center's work is the principle that there is a clear intersection between how food is produced and the impact on public health.

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