

Seafood and Omega-3 Supplementation During Pregnancy and Lactation can be Considered Still Safe after Fukushima Nuclear Accident.

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Abstract

Background: Scientific research is constantly expanding our knowledge of nutritional needs in pregnancy and lactation. In June 2014 the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) issued draft-revised advice encouraging pregnant women, those who might become pregnant, breastfeeding mothers and young children to eat more fish, a total of at least 8 ounces per week and to eat a variety of fish lower in mercury in particular anchovies, butterfish, catfish, clam, haddock (Atlantic), herring, mullet, oyster, perch (ocean), sardine, shad, trout (freshwater). However, the presence of radionuclides released from the damaged Fukushima Daiichi nuclear power plant in Pacific biota has aroused worldwide attention and concern.

Objective and Methods: Evaluating all the scientific literature available after the Fukushima nuclear disaster, the aim of this review is to demonstrate the safety of seafood products and the use of omega-3 supplements potentially derived from contaminated radioactive fish.

Results and Conclusions: There are no reasons to fear the amount of radiation in Japanese fish. The dose received from seafood consumption can be estimated to result in two additional fatal cancer cases per 10,000,000 similarly exposed people. The safest way to get omega-3 fatty acids during pregnancy is by taking a high-quality fish oil supplement, approved by a governing body that provides proof of quality such as the Council for Responsible Nutrition, the European Pharmacopeia Standard or the Norwegian Medicinal Standard and by the Food and Drug Administration or the Environmental Protection Agency [1, 2].

Pregnant and breastfeeding women do not need to cut fish out of their diet completely, and it may be safely eaten up to three times per week safely [3].

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Running head: Seafood and omega-3 still safe after Fukushima accident.

Key Words: Fish, Seafood, Omega-3 supplementation, Pregnancy, Lactation, Breast Feeding, Fukushima, Nuclear Disaster, Food and Drug Administration, Environmental Protection Agency.

Received : Aug 01, 2014;

Accepted : Dec 16, 2014;

Published : May 19, 2015

Introduction

The Necessity of Omega-3 Supplementation During Pregnancy and Lactation.

Scientific research is constantly expanding our knowledge of nutritional needs in pregnancy and lactation. In June 2014 the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) issued draft revised advice encouraging pregnant women, those who might become pregnant, breastfeeding mothers and young children to eat more fish, a total of at least 8 ounces per week and to eat a variety of fish lower in mercury, in particular anchovies, butterfish, catfish, clam, haddock (Atlantic), herring, mullet, oyster, perch (ocean), sardine, shad, trout (freshwater) [4]. Among the developments in this field, is the importance of omega-3 fatty acids in both the development of a healthy baby and in the health of the mother. Omega-3 fatty acids are essential and can only be obtained from the diet. Omega-3 fatty acids are critical for fetal neurodevelopment and are important for the correct duration of gestation and birth weight of the fetus. Many pregnant women may not get enough omega-3 fatty acids because the major dietary source, seafood, is restricted to two servings a week [5]. For pregnant women to obtain adequate omega-3 fatty acids, a variety of sources can be consumed such as vegetable oils, two low-mercury fish servings a week, and supplements (fish oil or algae-based docosahexaenoic acid (DHA)). The International Society for the Study of Fatty Acids and Lipids has established

the recommended minimum dosage of 300 mg docosahexaenoic acid daily in pregnant and lactating women.

Two polyunsaturated fatty acids (PUFAs), arachidonic acid (AA) and docosahexaenoic acid, are critical for the growth and development of fetal and infant central nervous system (CNS) [6, 7]. Embedded in the phospholipid cell membrane, AA is involved in cell signaling pathways and cell division, and serves as an inflammatory precursor for eicosanoids. The DHA concentration is high in retinal and brain membrane phospholipids, and it is involved in visual and neural function and neurotransmitter metabolism [8]. During the last trimester, the fetus accrues about 50 to 70 mg a day of one omega-3 fatty acid, DHA [9, 10]. Both maternal DHA intake and circulating DHA concentrations are important determinants of fetal blood concentrations of DHA [11]. Babies accrue DHA into the CNS up until about 18 months of age [12, 13].

An omega-3 dietary deficiency is compounded by the fact that pregnant women can become depleted in omega-3 fatty acids when the fetus uses Maternal Omega-3s for its nervous system development. After birth omega-3 fatty acids are also transferred through breast milk. With each subsequent pregnancy, mothers may become further depleted. Research has confirmed that adding EPA and DHA to the diet of pregnant women has a positive effect on visual and cognitive development of the baby [14].

Studies have also shown that higher consumption of omega-3 fatty acids may reduce the risk of allergies in infants [15, 16].

Omega-3 fatty acids have positive effects on the pregnancy itself. Increased intake of EPA and DHA has been shown to prevent pre-term labor and delivery, lower the risk of pre-eclampsia and may increase birth weight. Omega-3 deficiency also increases the mother's risk for depression. This may provide insight as to why postpartum mood disorders may become worse and begin earlier with subsequent pregnancies.

The best sources of EPA and DHA are cold water fish such as salmon, tuna, sardines, anchovies, and herring. Many people are justifiably concerned about mercury and other toxins in fish, especially during pregnancy, but there may be safe options available [3].

Contaminated Radioactive Seafood

Recent reports describing the presence of radionuclides released from the damaged Fukushima Daiichi nuclear power plant in Pacific biota [17, 18] have aroused worldwide attention and concern.

For example, the discovery of cesium-134 and cesium-137 in Pacific bluefin tuna (*Thunnus orientalis*; PBFT) that migrated from Japan to California waters [18] was covered by >1,100 newspapers worldwide and numerous internet, television, and radio outlets. Such widespread coverage reflects the public's concern and general fear of radiation. Concerns are particularly acute if the artificial radionuclides (such as cesium-137,

strontium-90, and iodine-131) are in human food items such as seafood. Although statements were released by government authorities indicating that radionuclide concentrations were well below all national safety food limits, the media and public failed to respond in measure. The mismatch between actual risk and the public's perception of risk may be in part because these studies reported radionuclide activity concentrations in tissues of marine biota but did not report dose estimates and predicted health risks for the biota or for human consumers of contaminated seafood.

Discussion

Which is the Amount of the Environmental Damage?

The Japanese government has reported that the Fukushima plant is leaking approximately 300 tons, or 71,895 gallons, of contaminated water each day. That's a lot of water, but nothing comparing it to the Pacific Ocean, which is estimated to contain 187,189,915,062,857,142,857 gallons. So as a quick comparison, even if the site continues leaking 72,000 gallons per day for 10 years, the total amount spilled would be 262.8 million gallons. This is undoubtedly a big amount of water, but it is still just 0.0000000014 percent of the volume of the Pacific Ocean [19].

Some studies predict that over the next 5 to 10 years, concentrations on the North American Pacific Coast could actually be higher than those off Japan, but the total amount of radioactivity will be well below the

current levels near the crippled nuclear plant because of dilution throughout the Pacific Basin [20].

Cesium will still be more concentrated in larger, carnivorous fish higher up the food chain, such as bluefin tuna than in smaller fish with diets consisting more of plankton and algae, but because it will flush out of the fish's flesh, concentrations will not necessarily mount over time.

An area of greater concern is the increasing quantity of strontium-90 detected in the waters near Fukushima. Unlike cesium, strontium accumulates in bone rather than muscle, and it is not rapidly flushed from the fish. The good news here is that aside from consumers of small fish such as sardines, which are eaten bone-in, most diners will not be eating strontium [20].

Wada et al. had inspected the radionuclide (iodine-131, cesium-134, cesium-137) concentrations in 6,462 specimens within 169 marine species collected off the coast of Fukushima Prefecture from April 2011. Only three specimens from two species (two from larvae of the sand lance, *Ammodytes*

personatus, and one from Hijiki seaweed, *Sargassum fusiforme*) exceeded the Environmental Protection Agency provisional regulatory limit for iodine-131 (2000 Bq/kg-wet) immediately after the nuclear accident. In 2011 and 2012, 63 and 41 species respectively exceeded the Japanese regulatory limit for radioactive cesium (100 Bq/kg-wet). The overall radioactive cesium concentrations of the total marine products have

decreased significantly. Radioactive cesium concentrations decreased quickly or were below detection limits in pelagic fishes and some invertebrates, and decreased constantly in seaweed, surf clams, and other organisms [21].

As of June 20, 2012, the Food and Drug Administration (FDA) has tested 1,313 samples of food imported from Japan, including 199 seafood samples. Of those, just one, a sample of ginger powder, exceeded the level considered safe for consumption. The FDA is not aware of any evidence suggesting that the domestic seafood catch contains harmful levels of radiation. Fisher et al. in their study found levels of cesium-137 and cesium-134 in bluefin tuna to be roughly 300 times lower than levels that would prompt FDA to investigate further to determine if there were a health concern [22].

The Banana Equivalent Dose (BED)

Nuclear radiation exists in many places in our daily lives. Perhaps the most commonly cited example is the common banana. Bananas have enough naturally occurring radiation that science communicators developed a metric called the Banana Equivalent Dose, or BED, as a means of explaining in user-friendly terms how much radiation a given thing emits. The BED represents the amount of radiation the body receives from eating one banana and roughly equates to 0.1 nanoseiverts. A seivert is the unit used to measure exposure. An arm x-ray is equivalent to 10 BED, a flight from New York to London: 400 BED, a chest computed

tomography: 70,000 BED, a fatal dose is roughly 80 million BED. Eating a serving of Pacific bluefin tuna will expose someone to roughly 1 to 5 BED, but this does not mean the potential harm is the same as eating a handful of bananas.

Radioactive risk, Pregnancy and Breastfeeding.

According to Buessler et al. and the FDA, there are no reasons to fear the amount of radiation in domestically caught fish. The dose received from seafood consumption can be estimated to result in two additional fatal cancer cases per 10,000,000 similarly exposed people [17, 22].

Uncertainties remain regarding the assessment of cancer risk at low doses of ionizing radiation to humans, especially among pregnant women. Some fish contain a large amount of mercury, which can be harmful to the offspring. Pregnant women avoid these high-mercury fish, which may result in a deficiency if they do not supplement from other Omega 3 sources. It is for this reason that many pregnant women substantially lack the omega fatty acids they need. According to the American Pregnancy Association, the safest way to get omega-3 fatty acids during pregnancy is by taking a high-quality fish oil supplement. Look for a supplement that is pure and has been approved by a governing body that provides proof of quality such as the Council for Responsible Nutrition, the European Pharmacopeia Standard or the Norwegian Medicinal Standard [1, 2, 23].

These standards guarantee quality products by setting maximum allowances on peroxides, heavy metals (0.01 parts per million), dioxins (2.0 parts per trillion), and polychlorinated biphenyls (0.09 parts per trillion).

Conclusions

Fish contains important nutrients for developing fetuses, infants who are breastfed, and young children. Fish provides health benefits for the general public. Many people do not currently eat the recommended amount of fish. Pregnant and lactating women do not need to cut fish and its derived products out of their diet completely. The Food and Drug Administration and the US Environmental Protection Agency unveil a proposal for updated advice that sets a first-time minimum of 8 ounces of a variety of fish each week from choices that are lower in mercury, equal to 2 or 3 servings, and recommend eliminating shark, swordfish, king mackerel and snapper from the diet, but other fish like salmon or trout may be eaten up to three times per week safely. Domestic fish (U.S.) have been found to be safe from a radioactive perspective, in particular anchovies, butterfish, catfish, clam, haddock (Atlantic), herring, mullet,

oyster, perch (ocean), sardine, shad, trout (freshwater).

Conflict of Interest

No conflict of interest or funding to disclose.

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