Benefits of Seafood Consumption and Omega-3 DHA During Pregnancy and Early Post-Natal Development

White Paper
From the Perinatal Nutrition Working Group, a program of the National Healthy Mothers, Healthy Babies Coalition

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BACKGROUND

Seafood is an Essential Part of a Healthy Diet

The many benefits of eating seafood start in the womb and continue through old age. Fish is the major source of omega-3 fatty acids in the diet and has long been known to decrease serum triglycerides, improve glucose tolerance and decrease the risk of sudden cardiac death and fatal arrhythmia and may protect against development of Alzheimer's dementia and certain types of depression. Over a dozen major health organizations including the American Dietetic Association, American Heart Association, American Diabetes Association, and Alzheimer's Association recommend eating fish two times per week for the many health benefits. (See Appendix A.) Oily fish like salmon, tuna, trout, and sardines are particularly high in the omega-3 long chain fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA).

Most recently, the 2010 Dietary Guidelines for Americans have recommended two 4 to 8 ounce servings of fish per week for pregnant and breastfeeding women to promote optimum fetal and neonatal cognitive development.[1] DHA is an essential nutrient that promotes healthy pregnancy outcomes and optimal infant cognitive development. **Most women do not get enough DHA during pregnancy and lactation to meet their infants' optimal developmental needs.** Since DHA accumulation in brain parallels the period of rapid brain development from the 26th week of gestation throughout the first two years of life[2] the need for the DHA in fish is especially high during pregnancy. During the last trimester of pregnancy, 60 – 70 mg/day of DHA are accreted in fetal brain each day and this increases to 70 – 80 mg/day during lactation.[3]

Although small amounts of omega-3 DHA can be derived from the short chain omega-3 fatty acid, α-linolenic acid, conversion is less than 0.1% [4] and cannot meet the needs for optimal DHA accretion during rapid periods of growth and development. The ability to convert α-linolenic acid to DHA is highly variable and is likely based on diet, gender and genetic variation in the ability to elongate and desaturate α-linolenic acid to form DHA.[5] It has recently been shown that conversion is greater in females of childbearing age than in men,[6,7] possibly because of the effect of estrogen on the desaturase genes.[8] Genetic variations in the desaturase gene clustered on chromosome 11 are involved in essential fatty acid metabolism.[9] Three single nucleotide polymorphisms in the desaturase gene cluster, including the minor variants rs174561 CC variant in the FADS1 gene (which codes for the delta-5 desaturase), the rs174575 GG variant in the FADS2 gene (which codes for the delta-6 desaturase, the rate limiting step in the conversion of α-linolenic acid to DHA), and a deletion defect in the rs3834458 intergene region are associated with low maternal phospholipid and red blood cell DHA levels[10] and low breast milk DHA concentrations.[11] Interestingly, infant IQ in response to breastfeeding is greatest in babies born to mothers who are homozygous for the major allele of the rs174575/FADS2 gene.[12]

Benefits of Seafood Consumption During Pregnancy

High intakes of long chain omega-3 fatty acids from seafood or fish oil supplements have been shown to increase gestational length and infant birth weight.[13,14,15,16] Birth weight and gestational age are important determinants of neonatal morbidity and mortality, subsequent neurocognitive development and risk for infant and childhood obesity. Therefore, promotion of optimal prenatal intake of seafood or DHA is important to pregnancy outcome.

The highest levels of maternal fish consumption during pregnancy have been associated with improved cognitive development, social skills and earlier acquisition of language in infants throughout the world.[17,18,19, 20] The ongoing British ALSPAC study demonstrated that infants born to mothers who consumed more than 320 gm. (11 oz.) of fish per week did better on tests of cognitive development than infants born to mothers who ate no fish during pregnancy; they had earlier acquisition of speech and better social skills.[17] Data from the Harvard Project VIVA in the United States show that children born to mothers with the highest seafood intakes during pregnancy and breastfeeding have better cognitive outcomes in both infancy and at three years of age.[18,20] Improvement in infant omega-3 DHA status in clinical trials of maternal DHA supplementation during pregnancy has been shown to improve neurocognitive development in infants.[21,22] Improved cognitive development has been shown in four-year-old children born to mothers with high baseline intakes of seafood who also received supplements of fish oil during pregnancy and breastfeeding.[23] Two of the most important determinants of infant cognitive ability in a large Danish birth cohort were shown to be the highest fish intake and the length of breastfeeding.[19]

The protective effect of breastfeeding on obesity in children has been recently reviewed.[27] Breastfeeding is consistently found to be protective against development of obesity in childhood[27,28,29,30] which is at least partially attributable to the DHA contribution of breastmilk compared to formula.[24,25,26] A recent study determined that at three years of age, breastfed children had lower BMI and were less likely to be obese (BMI ≥95 percentile) when compared to formula fed children.[31] There is increasing evidence that DHA, can reduce body fat in humans by increasing fat oxidation and suppressing fat deposition, preventing or reducing obesity.[32] Current evidence shows the fatty acid composition of the maternal diet during pregnancy and/or lactation can play a role in determining body composition of the child. [33,34] Breastfed infants of mothers supplemented with omega-3 PUFAs showed a significantly reduced BMI at 12 months compared to infants of non-supplemented mothers.[35] The effect has been attributed to DHA supplementation which reduced the rate of weight gain and resulted in decreased BMI in the breastfed infants at 21 months of age.[33,35] While additional clinical trials are necessary, current research strongly suggests that continued promotion of breastfeeding as well as DHA supplementation during pregnancy and lactation support lower BMIs and decreased obesity risk in children.

The Fish Paradox

Just about all seafood includes traces of mercury, a known neurotoxin. However, maternal seafood consumption during pregnancy is associated with improved, not impaired, cognitive development. The evidence for safe consumption of seafood during pregnancy has been exhaustively reviewed by the United States Department of Agriculture (USDA) and consistently shows the positive effect of seafood consumption by pregnant women on visual and cognitive development in their infants.[36] Even in populations which consume ten times the amount of seafood as women in the United States, such as those of the Seychelle Islands, no consistent adverse effects of methylmercury (MeHg) from fish can be demonstrated. In fact, in a 17 year follow up study of children born to mothers in the Seychelle Islands, no adverse effects were demonstrated on 21 of the 27 endpoints studied; children with prenatal MeHg exposure (reflecting higher maternal fish intake) did better on four endpoints and only two end points were slightly lower but only in males.[37] The authors concluded that ocean fish consumption during pregnancy is important for long lasting benefits on cognitive development in children.[37] In the Faroe Islands, a decrease of 0.1 IQ point was demonstrated among children whose mothers consumed the greatest amount of seafood, but about one-third of the seafood consisted of pilot whale meat; further analysis showed the protective effect of fish on the MeHg exposure from pilot whale.[38] In 2004, the concern for mercury exposure, largely resulting from the Faroe Islands data, prompted the United States Food and Drug Administration (FDA) and Environmental Protection Agency (EPA) to issue joint consumer advice regarding mercury in fish and shellfish. This advice was specifically addressed to women who are or might become pregnant, nursing mothers and young children. In order to understand the ramifications of the advice, it is important to evaluate both what it says and how it has been interpreted. The advice opens by explaining, “a well-balanced diet that includes a variety of fish and shellfish can contribute to heart health and children's proper growth and development.” But this is followed by information about mercury, including the statement that “some fish and shellfish contain higher levels of mercury that may harm an unborn baby or young child's developing nervous system” and the following recommendations:

- Do not eat shark, swordfish, king mackerel or tilefish because they contain high mercury levels;
- Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are lower in mercury, such as shrimp, canned light tuna, salmon, pollock, and catfish;
- Albacore (“white”) tuna has more mercury than canned light tuna, therefore when choosing your 12 ounces of fish and shellfish, you may eat up to 6 ounces (1 average meal) of albacore tuna per week; and
- Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers and coastal areas and, when advisories are not available, generally do not eat more than 6 ounces (1 average meal) per week of fish from local waters and do not eat any other fish during that week.
- Although the FDA/EPA joint advice recommend eating fish for the many health benefits, many families have interpreted the guidance as a “warning” to limit or avoid all fish.[39,40] Discussions of the seafood advice with pregnant women have shown that women are vaguely aware that mercury is harmful and not aware of the benefits of seafood during pregnancy and lactation, but would be willing to eat fish if their obstetrician recommended it and if they had an authoritative list of which fish to eat.[41]

Consequence: A Growing Seafood Deficiency

America is facing a lost generation of seafood eaters. Recent data from the FDA show that American women eat well below the amount of fish needed for optimum health. Pregnant women eat 1.89 ounces per week; postpartum women eat 2.17 ounces per week; and nonpregnant women eat 2.97 ounces per week. Additionally, less than one percent of women consume any of the four higher-mercury fish (shark, swordfish, king mackerel, and tilefish) advised against by the FDA.[42] The consequence of inadequate seafood intake by pregnant women and children is omega-3 deficiency. In a recent study it was shown that women consume much less seafood than men, even though they have higher needs associated with pregnancy and breastfeeding.[5] Families that do not eat seafood are unlikely to offer it to their children. A national consumer behavior survey found that 65 percent of parents feed their children seafood less that twice per week and reported that they rarely or never ate seafood themselves as a child; 91 percent of parents with children under 12 years confirm that their children are not getting the recommended two servings of seafood per week.[43]

Conclusion and Recommendation of the Perinatal Nutrition Working Group (PNWG) of the National Healthy Mothers, Healthy Babies Coalition

It is the opinion of the PNWG that women who want to become pregnant, are pregnant, or are breastfeeding should eat at least 12 ounces of seafood per week for the many health benefits. The long chain omega-3 fatty acids (DHA and EPA) enhance visual, cognitive, motor skill and behavioral development in children and may reduce preterm labor and the risk of obesity in children. This recommendation is intended to prevent a nutritional deficiency of the long chain omega-3 fatty acids. Consumption of whole fish rather than fish oil supplements is the best public health approach. Whole fish rather than fish oil supplements have been more frequently linked to reductions in preterm labor and improved neurocognitive development and provide lean protein and other beneficial nutrients such as selenium and vitamin D.

Appendix A

Organization	Document	Seafood Recommendation
Alzheimer's Association	Adopt a Brain-Healthy Diet	Increase your intake of protective foods. Current research suggests that certain foods may reduce the risk of heart disease and stroke, and appear to protect brain cells. Cold water fish contain beneficial omega-3 fatty acids: halibut, mackerel, salmon, trout and tuna.
American Diabetes Association	Managing Preexisting Diabetes for Pregnancy: Summary of evidence and consensus recommendations for care	Due to the risks of CVD or hypertriglyceridemia, diabetic women are encouraged to eat at least two meals of oily ocean fish per week to increase n-3 fatty acids (eicosapentenoic and docosahexanoic acids), but pregnant women should avoid eating fish potentially high in methylmercury (e.g., swordfish, king mackerel, shark, or tilefish).
American Dietetic Association	Nutrition Fact Sheet: DHA, A Good Fat	DHA is important for proper brain and eye development, especially during pregnancy and infancy. Beginning in the last trimester of pregnancy and continuing through the first 2 years of life and beyond, DHA levels in the brain rapidly increase. Several studies have shown that infants with higher blood levels of DHA score better on tests measuring their brain (or cognitive) and visual function. Women can meet the recommended intake of DHA by consuming two servings of fish, especially fatty fish, per week.
American Heart Association	Fish and Omega-3 Fatty Acids	We recommend eating fish (particularly fatty fish) at least two times a week. Fish is a good source of protein and doesn't have the high saturated fat that fatty meat products do.
American Optometric Association	Nutrients for Eye Health	Consume 500 mg/day DHA/EPA essential fatty acids from sources including flax or fleshy fish like tuna or salmon, or fish oil supplements. Daily intake of these nutrients through foods and/or supplements has been linked to healthy eyes and may reduce risk of some chronic eye conditions.

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About the Perinatal Nutrition Working Group

A program of the National Healthy Mothers, Healthy Babies Coalition, the Perinatal Nutrition Working Group (PNWG) is comprised of top professors of obstetrics, doctors of nutrition and registered dietitians who serve as an evidence-based resource to physicians, organizations and women as they evaluate eating seafood during pregnancy. The amount of fish women should eat is the subject of professional debate, but there is agreement that women do not enough seafood. The PNWG is committed to correcting the misinformation surrounding seafood. Through collaborative, multidisciplinary efforts, the Perinatal Nutrition Working Group aims to:

- Evaluate the current science regarding the risks and benefits of eating seafood during the perinatal period via in-person meetings and in ongoing virtual dialogue;
- Establish and share nutritional recommendations for seafood consumption for women who want to get pregnant, are pregnant or are breastfeeding;
- Collaborate with authors and scientists to publish review papers, thought pieces, white papers, and position statements on the value of seafood in the diet;
- Support policy initiatives in developing effective ways to help patients understand the value of eating seafood during the perinatal period; and
- Serve as ambassadors to professional, media, and consumer audiences about the topic of maternal and child nutrition.

For more information, please visit www.hmhb.org/pnwg.

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