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Current Perceptions Regarding the Importance and Safety of Fish Consumption and Omega-3 Fatty Acid Supplementation Among Pregnant Women

by

Jessica L Ess

Thesis

Submitted to the School of Health Sciences
College of Health & Human Services
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in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE
in
Dietetics

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Abstract

**Background:** Previous studies suggest many pregnant women are under-consuming fatty fish and are deficient in omega-3 (ω-3) fatty acids.

**Objective:** To determine current perceptions regarding the importance and safety of fish consumption and ω-3 fatty acid supplementation among pregnant women.

**Methods:** A 10-question survey distributed to expectant mothers via an online survey and via paper form through 3 obstetric clinics over a 2-month period.

**Results:** Of the 104 participants, 82% consumed less than 2-3 servings of fish per week, and at least 30% were confused about mercury content. Over 60% of doctors did not provide recommendations regarding ω-3 intake. One-third of participants neither consumed the recommended amount of fish nor took an ω-3 supplement. Nearly 98% took an ω-3 supplement when advised by a doctor.

**Conclusion:** Knowledge regarding the safety and importance of fish consumption and/or ω-3 fatty acid supplementation during pregnancy is inconsistent. Improved informational standards may be warranted.
Chapter 1:  
Introduction to Study

Introduction

The debate regarding the importance of a diet rich in ω-3 fatty acids has shifted from speculative in nature to nearly unequivocal in recent decades. Several medical conditions are being linked to essential fatty acid deficiencies that start during infancy, and ongoing research is building the case for the health benefits these fatty acids offer throughout the lifespan. Fish, shellfish, and marine oils have been identified as the most significant dietary sources of ω-3s, and it is recommended that Americans consume 2 to 3 servings (8-12 oz) of low-mercury fish and shellfish every week (1, 2). However, despite these findings, it is estimated that only 36% of the population follows these guidelines (3). Among those most at risk for deficiency are expectant mothers and their developing fetuses. A 2003 survey suggests that, on average, pregnant women are consuming less than one fourth of the recommended fish intake (4). Advice from doctors, messages from the media, and self-led research all drive health-related behaviors (5). Not only is this advice varied in content, but access to it differs as well.

Background

Studies continue to correlate dietary changes and the subsequent shift in our fatty acid profiles to the incidence of several chronic diseases. For instance, higher saturated and trans fatty acid intake is strongly associated with higher total cholesterol and LDL (low density lipoprotein) levels (6). Other research based on estimated dietary intakes suggests that the consumption of just 250-500 mg of combined eicosapentaenoic acid (EPA) and
docosahexaenoic acid (DHA) per day decreases cardiac mortality by at least 35% (7). This effect, which is at least as great as that of statin therapy, has led the American Heart Association to recommend at-risk patients to increase their consumption of plant- and marine-derived ω-3 fatty acids (8, 7). Preliminary research also ties ω-3 deficiencies with inflammatory conditions including irritable bowel disease (IBD), asthma, and even certain types of cancer (7). The Nurses Health Study has demonstrated an inverse association between ω-3 fatty acid intake and type 2 diabetes, which suggests their importance in controlling blood sugar and preventing insulin resistance (2). There is even growing interest in how ω-3s communicate with and regulate genes and the immune response (9).

While this exciting research continues to support the importance of essential fatty acids (EFAs) throughout adulthood, it is well known that a most critical period for EFA utilization is during fetal and infant development (10). There are several fatty acids needed by the body; however, those most likely to be deficient and, therefore, of interest to this study are the ω-3s EPA and DHA. EPA is a precursor to eicosanoids, substances that regulate vasoconstriction, vasodilation, platelet function, and inflammation (2). DHA plays a complex role in neural and retinal development during the fetal and infant stages. While the body can convert other fatty acids into EPA and DHA, it is now believed that this conversion is very slow and, therefore, nearly negligible (11). Natural food sources of EPA and DHA are marine-based and include specific types of fatty fish, shellfish, and algae (12).

**Statement of Problem**

Fish and shellfish are part of a healthy diet and are now known to be the only significant dietary sources of preformed DHA and EPA (2). Unfortunately, certain types of
fish contain potentially toxic levels of methylmercury, a neurotoxin that can disrupt nervous system development (13). Accordingly, the US Food and Drug Administration (FDA) issued a public advisory in January 2001, warning pregnant women to avoid certain long-lived, predatory fish such as swordfish, shark, king mackerel, and tilefish and to limit consumption of others (14). There is evidence that this and other public advisories may have caused an overall fear of and decline in fish consumption, especially among pregnant women (4).

There are several reasons to believe that Americans and pregnant women, especially, are not receiving enough ω-3 fatty acids in their diets. The most widespread issue may be that many families rely on fast, easy, cheap meals; rarely does fresh fish meet these criteria. In addition, some pregnant women may confuse warnings about the risk of parasitic infections from eating raw fish and end up avoiding fish consumption altogether. Heeding public advisories about mercury toxicity from fish, others are apprehensive about which types, if any, are safe to eat (4). Further confounding the lack of intake, the fish that does get eaten may not be of sufficient quality to offer much benefit. The underlying cause of this confusion may be a lack of sufficient dietary education. Is there a need for public health education reform that standardizes recommendations available to all pregnant women?

**Purpose of Study**

While education reform will require more conclusive research to explore specific dietary guidelines, optimal intakes, and confounding lifestyle variables, a first step may be to assess the present-day dietary climate. Previous studies have found a decline in fish-eating following public health advisories; but there have been no recent large-scale studies published on the fish-eating behaviors of pregnant women (3, 4). The purpose of this study
was to determine the current perceptions among pregnant women regarding the importance and safety of dietary ω-3 fatty acids and, more practically, the conscious decision to include fish, fish oil, or some form of supplemental DHA/EPA in the diet during pregnancy.

The research method consisted of a short survey distributed to expectant mothers while they waited to be called into an examination room for their obstetric checkup. The 10-question survey captures opinions and perceptions regarding the safety and importance of fish consumption and/or ω-3 supplementation. It reveals how dietary habits may or may not correspond to these perceptions. The responses also help characterize the impact of a doctor’s recommendations as displayed by chosen behaviors.

Summary

In summary, there is growing interest in the crucial role of ω-3 fatty acids in the diets of pregnant women. There is also reason to believe that many pregnant women may not be obtaining sufficient levels to support the developmental needs of the fetus (9, 15). Research points to fish and/or fish oil supplements as the most beneficial forms of dietary EPA+DHA (7). Amidst scares of mercury toxicity and parasitic infections confounded by an overall lack of factual knowledge, pregnant women as a population may not be consuming enough fish or supplementing sufficiently. This study aimed to identify whether a sample of pregnant women understands the importance of eating fish and/or including an ω-3 supplement, as well as whether their diets parallel that understanding. Following is a review of literature to support the rationale for study.
Chapter 2:  
Review of Literature

Introduction

In order to understand why the consumption of fish and/or ω-3 supplements is so crucial during pregnancy, it is necessary to review how fatty acids are derived and utilized by the body. Two essential fatty acids (EFAs) – omega-3 (ω-3) and omega-6 (ω-6) – are needed specifically for immune function, vision, cell membrane structure, and hormone production, among several other physiologic functions (15). Like all EFAs, ω-3 and ω-6 cannot be formed in sufficient quantities by the body alone. As previously mentioned, ω-3 are found in such foods as flax seed, walnuts, certain vegetable oils, and fatty fish like salmon, trout, tuna, sardines and anchovies; the more abundant ω-6 are found in several foods including margarine, fried and baked products, meat, poultry, eggs, nuts, and liquid vegetable oils (2).

Essential Fatty Acids: An Overview

The 18-carbon EFAs α-linolenic acid (ALA) and linoleic acid (LA) are precursors to the 20+ carbon long-chain polyunsaturated fatty acids. ALA is the precursor to the ω-3s, EPA and DHA. LA is the precursor to the ω-6, arachidonic acid (ARA) (see Figure 1). ALA and LA are considered essential, because human and animal cells cannot synthesize double bonds until after the n-9 carbon (9th carbon from the methyl end, ω-9); therefore, they must be supplied by the diet (16).
Various proportions of EFAs are present in all cells and tissues, as they play vital roles as structural components of phospholipid membranes and, as recently suggested, messengers in the direct control of gene expression (17). EPA, DHA, and ARA play particularly important roles in the retina, brain, and other neural tissues. They contribute to membrane fluidity, which is essential for proper cell functioning (18). They are also precursors to eicosanoids, which play complex roles in inflammation, immunity, and as messengers in the development of the central nervous system. While various EFAs are the topic of ongoing research regarding lifelong health and disease progression, this discussion will focus on the necessity of the ω-3 fatty acids DHA and EPA during the period which may be “the greatest opportunity to influence developmental outcomes,” pregnancy and early infancy (11).

**DHA and Cognition**

The biochemical development of the human brain and central nervous system (CNS) begins during fetal development and continues after birth. DHA and ARA are the main fatty acids in the gray matter of phospholipids of neural membranes, and they are required for...
CNS development. The tissues of the brain and CNS are especially rich in DHA, and studies have presented evidence to suggest that ω-3 deficiency impairs cognition (15, 19).

A longitudinal study in 2007 found that, between the ages of 6 months and 8 years, children of mothers who consumed higher levels (≥ 349 grams) of seafood per week during pregnancy (versus those who consumed none) scored higher on verbal intelligence quotients (2). Infants fed DHA/ARA supplemented formulas (versus non-supplemented formulas) for the first 4 months resulted in higher scores on problem-solving tests at 10 months of age (10). In 2008, a study led by Oken et al. tested the cognitive abilities of 3-year old children whose mothers consumed at least 2 servings of fish per week versus those whose mothers consumed less than an average of 1.4 servings per month. Using tests of picture vocabulary and visual motor abilities, it was found that children of fish-consuming mothers scored significantly higher (10).

In support of these correlations between DHA and cognitive development, ongoing research also links deficiencies to cognitive decline occurring later in life. A study by Vancassel et al. found a correlation between autism and DHA deficiency after comparing DHA concentrations in the brains of autistic and non-autistic children. Therapeutic efficacy, however, remains unclear (19). The Chicago Health and Aging Project (CHAP) found that consumption of just 1 serving of fish per week correlated to a 60% reduction in the risk of developing Alzheimer’s disease over 3.9 years. Several other similar studies are currently underway (7).

While the biochemical role of ω-3 fatty acids is not yet fully understood, recent studies suggest that they may play a role in genetic expression throughout early development by directly controlling transcription (17). In a study of baby rats whose mothers were fed an
ω-3 rich diet, the transcript level of calmodulin, a protein involved in the plasticity of the
CNS, was found to be up-regulated 12-15 days after birth. In contrast, mRNA levels of rats fed ω-3 deficient diets revealed the down-regulation of several genes involved in
myelination. Of 1,600 genes examined, several showed altered expression in the ω-3
deficient rats, even 8 months after birth. For example, the DEAD-box gene – which is
required for all processes involving RNA molecules, especially translation initiation – was
repressed (17). It is reasonable to suggest that similar regulatory mechanisms may persist
throughout the lifespan.

**DHA and Vision**

Like the brain, proper visual development also demands a sufficient supply of EFAs – particularly the ω-3 DHA – during pregnancy and early infancy. An early study conducted
on rhesus monkeys in 1984 found that, in infant monkeys of mothers fed a low ω-3 diet,
visual acuity dropped by one fourth at week 4, and by half at week 8 following birth (20).
DHA affects the photoreceptor membranes involved in rhodopsin activation, rod and cone
development, and the signal transduction process. Numerous studies to date have supported
these earlier findings.

In 2008, Innis et al. led a study describing an approach to identify DHA deficiency
using only visual acuity measures (21). In another recent study, retinal sensitivity to light
and visual acuity was found to increase when preterm infants were fed a formula
supplemented with ω-3 fatty acids (10). Rhodopsin, a protein that accounts for 90% of the
protein content in the disc membranes of the eye, has increased mobility when surrounded by
DHA. DHA is presumed to enhance the rod photoreceptor response by increasing both
rhodopsin cell membrane fluidity and the excitability of the photoreceptor signal transduction process. This process increases retinal sensitivity to light, thereby enhancing visual acuity (10).

**EPA**

The ω-3 EPA is an essential structural component of every cell in the body, and it plays an important physiologic role in regulating the action of other fatty acids (9). EPA facilitates the transport of DHA and ARA across the placenta by regulating the mRNA expression of fatty acid transport proteins (9). Therefore, fetal DHA and ARA concentrations are dependent upon maternal EPA concentrations. It is becoming clear that fatty acids work in concert, often relying on the same enzymes and substrates for action, so a careful balance in their proportions is necessary.

As previously mentioned, EPA is also a precursor for specific types of prostaglandins, thromboxanes, and leukotrienes, collectively known as eicosanoids. The specific eicosanoids derived from EPA have anti-inflammatory effects and, therefore, counteract those inflammatory eicosanoids derived from ARA. Clinically, this means that a diet with excessive ω-6 ARA in relation to ω-3 EPA can lead to preterm deliveries and preeclampsia (21). A 2002 Danish study supplementing pregnant women with either fish oil (2.7 g), olive oil, or no supplement found that women in the fish oil group delivered babies an average of 107 g heavier and had 4 days longer gestation periods (22). Interestingly, EPA is currently being studied for its potential in treating mental illness, especially schizophrenia and depression (23). Although these diseases occur later during adolescence and adulthood, their development may begin with deficiencies during infancy.
**Increased Need: Pregnancy**

Due to the rapid growth of tissues and the complex development of the fetal brain and retina, pregnancy demands a higher dietary intake of EFAs – especially of the ω-3 variety – by the mother. Total PUFA levels of pregnant women were found to be about 10% less, while ω-3 were nearly half those of non-pregnant women (15). ω-3 are synthesized in the maternal liver and transferred to the fetus via the placenta. Research by Uauy et al. (2001) suggests that “the fetus and placenta are fully dependent on maternal EFA supply for their growth and development” (10). Even in times of low maternal circulation, any ω-3 fatty acids entering fetal circulation will be accrued by the fetus (15, 10). If the supply is low, the mother will be the first to suffer deficiency; if the supply is excessively low, both the mother and fetus may be dangerously deficient.

There is an increased metabolic demand for ω-3 fatty acids particularly during the third trimester of pregnancy, when most vascular and neural growth occurs (10). Postmortem tissue analysis of preterm infants shows less retinal and brain cortex PUFAs than in infants born at term. Levels of fetal ω-3 measured during the third trimester by cordocentesis show that the fetus takes about 70 mg of DHA from the mother per day. The median dietary intake of DHA is estimated at 52-93 mg per day (11). It has been found that the losses to the infant exceed the dietary intakes of most women, thereby suggesting many diets may be deficient (16).

**Increased Need: Lactation**

The increased ω-3 demand during the third trimester extends to the lactation period, when the fetus acquires these fatty acids through breast milk (10). In fact, maternal PUFA
levels decrease during pregnancy and remain low for at least 6 weeks beyond. The fatty acid profiles of women during lactation indicate even greater deficiencies than during pregnancy of $\omega-6$ and $\omega-3$, due to the transfer of PUFAs from mother to fetus. The basal requirements for total EFAs, which are estimated at 3% of total calories for non-pregnant women, may be 4.5% during pregnancy and at least 5-7% during lactation (15).

**Breast-feeding and Formula-feeding**

Breast milk is the preferred form of infant feeding because it naturally contains DHA and ARA, among other reasons. The usual ratio of breast milk falls somewhere between 5:1 and 10:1 ($\omega-6:\omega-3$), but this depends on the diet, age, and maternal disease status (10). Research also shows that the fore milk tends to be higher in sugar whereas the hind milk tends to be higher in fat, so length of time at breast is important as well. For women who do not breast-feed, supplemented formulas are widely supported; over 90% of the formulas on the U.S. market are supplemented with DHA and ARA (12).

The American Dietetic Association (ADA) states that there is “consistent evidence that preterm infants do benefit from DHA and ARA formulas” (2). It is also the position of the ADA that while there is no evidence that $\omega-6$ intake in infants is inadequate, lower blood lipid and brain levels of DHA have been found in infants fed formulas lacking DHA (2). This finding suggests that low dietary $\omega-3$ intake can have a negative effect on infant development.

However, breast-feeding women should not assume that their bodies contain sufficient levels of EFAs to support their infants’ needs. As previously stated, the average American diet provides just 52-93 mg of DHA per day – far below the 200-500 mg minimum
recommended by experts (11, 4). As awareness of the importance of DHA continues to grow, it is becoming apparent that nursing mothers may need to supplement their diets with DHA+EPA (9).

**Dietary Intakes**

EPA and DHA can be synthesized from other ω-3 sources; however, the conversion of ALA to EPA has been shown to be slow and minimal, while the conversion of ALA to DHA is miniscule (2, 11). Therefore, an adequate supply of ALA does not confer an adequate supply of DHA. In fact, evidence shows that increasing dietary ALA in a pregnant woman does not increase the DHA of her infant, presumably because the conversion is not significant enough in the 9-month time span (2). However, increasing DHA in mothers does increase the transfer of DHA to the fetus during pregnancy (via the placenta) as well as to the infant after birth (via breast milk) (2). Practically, this means that plant sources of ω-3 (flax seeds, walnuts, and soybean oil) may not be sufficient for physiologic needs during pregnancy. A reliance on only plant-based oils to supply the entire recommended intake would result in the consumption of too many calories from fat (9). Oils obtained from fish provide preformed EPA and DHA, ready for immediate use by the body.

Most experts agree that the fatty acids most likely to be deficient are EPA and DHA, but opinions are mixed when assigning optimal intakes. The ADA and Dietitians of Canada set the acceptable macronutrient distribution range for ALA at 0.6-1.2% of total energy, but their recommendations for EPA and DHA are less clear (2). A Recommended Dietary Allowance (RDA) cannot be established due to a lack of data or an uncertainty in the existing data. The ADA recommends that pregnant and lactating women should get no less than 200
mg of DHA per day, preferably through preformed DHA versus the precursor ALA (2). However, the ADA’s values are based on average US intakes, which may not represent an optimal intake. The minimum level was set even higher – 300 mg/day – at the Workshop on the Essentiality of and Recommended Dietary Intakes for Omega-6 and Omega-3 Fatty Acids in 1999. Some experts recommend more still – as much as 500 mg/day (24).

The ADA, the American Heart Association and the Dietary Guidelines Advisory Committee all recommend pregnant women consume 2 to 3 servings (8-12 oz) of fatty fish per week (2, 24, 16). Two servings per week of low-mercury, cooked, fatty fish which is equivalent to 8 ounces provides approximately 3,500 mg or 500 mg/day of combined EPA and DHA (2). The Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) advise women who may become pregnant, pregnant women, nursing mothers, and young children to avoid large, predatory fish that may be high in mercury and to consume lower mercury fish and shellfish (16). Fish oil supplements are also an option. The amount of EPA/DHA per 1000-mg capsule varies, although it usually falls in the range of 300-500 mg (9). The source must also be tested for purity, as mercury levels are a concern without ample purification (25). The increased need of ω-3 fatty acids during early infancy as well as the evidence showing the drop-off in ω-3s available to the mother and, therefore, to the infant, suggest that without a sufficient diet, diet therapy and/or supplementation may be beneficial.

The ω-6:ω-3 Ratio

The most recent research suggests that rather than the absolute levels of ω-6 and ω-3 provided by the diet, it is actually the ratio of these EFA levels that is crucial (10). An
overabundance of ω-6 in relation to what may be an otherwise sufficient level of ω-3 can actually result in an ω-3 deficiency. Human and animal livers elongate and desaturate the parent EFAs (LA and ALA) to form the ARA, EPA, and DHA derivatives. An enzyme (Δ^6-desaturase) desaturates ω-3, ω-6 and n-9. This process is competitive and depends on the relative amounts of these fatty acids in the body. Studies show that when dietary ω-6 is high, Δ^6-desaturase expression is repressed via negative feedback. This means that in ω-3 fatty acid deficiency, the ω-6 accumulate while DHA decreases in plasma and tissue lipids (10).

**The Excessive ω-6 American Diet**

These findings, which suggest the importance of the ratio rather than the absolute level, are critical; population studies on the American diet reveal that, on the whole, we are not paralleling these ratios (26). While the media have helped to create a buzz around the importance of consuming a diet rich in essential fatty acids, many Americans are overemphasizing ω-6, which act as pro-oxidants and contribute to inflammatory and autoimmune diseases in excess amounts. Consumption of ω-6 has increased in the US and Canada from 3% in the 1930s to 5-6% currently (2). This increase in ω-6 is likely due to greater consumption of meat, poultry, eggs, and corn oil, which contain significant ω-6 in the form of ARA. For perspective, just 1 teaspoon of corn oil satisfies daily ω-6 needs. Currently, most Americans exceed this by 10 to 20 times (9). This is not surprising considering the ω-6 content of beef is higher now than in generations past, as farmers have adopted the method of feeding their cows corn – a much cheaper, more calorie-rich feed than their native diet of grass (7).
Given the increase in \(\omega\)-6 intake, it is likely that what little \(\omega\)-3-rich foods are consumed will get out-competed in a saturated \(\omega\)-6 environment. The current average US ratio of \(\omega\)-6:\(\omega\)-3 falls somewhere between 15:1 and 16.7:1 but can sometimes reach 30:1. Humans are believed to have evolved on a ratio closer to 1:1 during Paleolithic times, and several studies have associated low ratios such as 2:1 or 4:1 with decreased chronic disease risk (26). Due to the potential benefits and the lack of adverse effects, most experts propose a ratio of 4:1 (10).

The current ratio is not surprising; \(\omega\)-3 fatty acids are more difficult to include in the diet, because they are rarely found in processed, ready-to-eat foods. \(\omega\)-3 fatty acids are more susceptible to rancidity and spoilage by oxidation than \(\omega\)-6, because the last double bond is geometrically and electrically more exposed. The increased fragility helps to explain why \(\omega\)-6-rich oils such as corn, sunflower, peanut, and cottonseed are more available in grocery stores and restaurant dishes. When exposed to heat, light, or oxygen, \(\omega\)-3 fatty acids are especially susceptible to oxidation, which destroys their nutritional value. Flax seeds are one of the rare plant sources of \(\omega\)-3 fatty acids due to their hard shell, which protects the oil from heat, light, and oxygen. However, flax seeds must be freshly ground before consumption as the teeth are unlikely to crack open each seed, and the body cannot digest the hard shell to extract the oils. The high degree of instability of \(\omega\)-3 oils further complicates our ability to incorporate them into our diets. With this overabundance of \(\omega\)-6, some experts recommend that “the amount of plant oils rich in omega-6 needs to be reduced, [and] simultaneously, omega-3 [consumption] needs to be increased in the diet” (24).
**Risks of Mercury Toxicity**

To exacerbate the overall lack of ω-3 and abundance of ω-6 in the average diet, many mothers are at risk for severe deficiencies if they avoid consuming fish for fear of consuming toxic levels of mercury. There is evidence suggesting that some fish contain levels of mercury which, although not toxic to adult mothers, may put the developing fetus at risk for preterm delivery by producing oxidative stress at the cellular level (13).

A 2001 study known as POUCH (pregnancy outcomes and community health) followed 1,226 women in Michigan with variable diets and found methylmercury to be “a major source of mercury exposure for pregnant women” (13). This study found that women who delivered less than 35 weeks gestation were more likely to have higher mercury levels. However, only 44 (<4%) of the 1,226 women had preterm deliveries. Furthermore, 10% of the women who did not eat fish also had moderate to high mercury levels. These results highlight that this and other studies lack information on the levels of other fish pollutants such as polychlorinated biphenyls (PCBs) as well as environmental pollutant exposure (i.e. work environment, homes, etc.) (13).

Other studies on fish consumption and length of gestation suggest a negative association between fish intake and preterm delivery. In a 2002 study conducted on 8,729 pregnant Danish women, preterm delivery and low birth weight were associated with low fish consumption (22). Similarly, in the coastal communities of the Faroe Islands where fish is a dietary staple, high birth weights and long gestations have been observed, suggesting that ω-3 fatty acids can increase birth weight by prolonging gestation (22). Some experts believe that there may be a threshold of minimum intake needed to achieve benefits from fish consumption during pregnancy and early infant development (11).
Due to the lack of conclusive research, the Food and Drug Administration (FDA) and the Environmental Protection Agency have issued public advisories to guide consumers on safe, low-mercury fish consumption. Methylmercury bioaccumulates in large predatory fish, because they have longer life spans and consume more mercury-containing prey. Therefore, the Environmental Protection Agency and FDA recommend that women who may become pregnant, pregnant women, nursing mothers, and young children avoid large, predatory fish that may be high in mercury and to consume lower mercury fish and shellfish (1). Specifically, they advise these high-risk groups not to eat shark, swordfish, king mackerel, and tilefish. They recommend 2 to 3 servings of low mercury fish and shellfish and state that the 5 most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish. Albacore tuna, also called "white" tuna, contains more mercury than canned light tuna. The Environmental Protection Agency and ADA now allow up to 6 ounces of albacore tuna per week (1, 2).

**Benefits Versus Risks**

There are conflicting opinions over whether or not increased dietary intake and/or supplementation for mothers and infants is appropriate because there are still many questions left unanswered. For instance: what is the optimal ratio of $\omega-6:\omega-3$, and in what form should the EFAs be consumed or supplemented, and when? While there are still questions, evidence suggesting the risk of increased $\omega-3$ intake is lacking. The ADA states that since there are a number of possible benefits and a “lack of evidence of adverse effects,” all non-breast fed infants should be fed formula with ARA and DHA for the first year (2). There is also a growing body of literature suggesting that diets higher in EPA and DHA confer further
protection from chronic disease (7). A study supplementing women with 3 grams of EPA+DHA – nearly 20 times the average intake of pregnant women in the US – failed to show an increased risk of birth complications (16). Additional research suggests that consuming more than 2 to 3 servings of fish per week may be more beneficial for cardiovascular health (11). Many experts argue that the benefits of a diet rich in seafood and other sources of essential fatty acids far outweigh the risks.

Public Sources of Information

If pregnant women are confused about whether or not they should include fish in their diets, misleading public announcements may be part of the cause. In 2001, the FDA issued a public warning stirring headlines such as, “Mercury contamination of fish warrants worldwide public warning” (27). In 2001, the popular WebMD® website published an article with this headline: “FDA warning: harmful mercury levels in some ocean fish a danger to babies” (14). While this article does state that women should not avoid all fish, there are no detailed reasons given as to why fish consumption is important. It is possible that pregnant women seeing these headlines read the articles, and it is possible they conduct further self-led research on the benefits of fish consumption. However, it is reasonable to suggest that many women, whether consciously or subconsciously, might choose to avoid fish altogether.

In 2004, the Environmental Protection Agency and FDA published a joint warning about the risks of consuming certain types of fish. This statement advised against the consumption of large, predatory fish such as shark, swordfish, king mackerel, and tilefish, due to high levels of mercury. However, it is also stated that up to 12 ounces of fish per
week that are lower in mercury is permitted. Unlike other warnings, though, this article does mention that dietary fish contain ω-3 fatty acids and can promote children’s proper growth and development (1).

It is unclear whether or not obstetricians and other healthcare practitioners are informing expectant mothers about dietary guidelines. Doctors formulate their own opinions regarding the efficacy of supplementation and the necessity of a balanced diet that include ω-3s, and they are free to practice according to these opinions. Unfortunately, there exists no standard for practice. Perhaps the greater issue, however, is the lack of time during most rushed doctor’s appointments for discussions regarding diet. Future studies might survey physicians to characterize the overall style of practice.

Previous Survey Studies

Media messages and physician recommendations aside, the most important question is whether or not pregnant women are consuming sufficient ω-3s. While few in number, previous studies have sought to characterize fish consumption and ω-3 supplementation opinions and behaviors. A 2003 survey study conducted on 2,235 pregnant women found that, following the 2001 FDA public advisory, fish consumption decreased by an average of 1.4 servings per month (4). A public opinion survey published in 2005 by the Center for Food, Nutrition and Agriculture Policy (CFNAP) suggested many of the 1,040 adult Americans surveyed (pregnant and otherwise) had changed their seafood consumption patterns after hearing about mercury warnings; however, this study did not specifically assess pregnant women (3).
The most recently published study comes from Burger and Gochfeld (2009), who surveyed 329 people fishing, walking, and engaging in other recreational activity in the New York/New Jersey harbor region. They found that while many of the participants were confident in their knowledge about the risks and benefits of fish consumption, their knowledge base was inaccurate and lacking. Participant knowledge of which fish were high-mercury did not match actual mercury levels of those fish (28).

While the findings of these studies are important, there have been no recent US studies published on the fish-eating behaviors of pregnant women, and the number of women using dietary ω-3 supplements is unknown. This study seeks to characterize the current dietary climate by surveying pregnant women in obstetric offices to determine their perceptions regarding the safety and importance of fish consumption or ω-3 supplementation. The results of this study may highlight a need for prenatal dietary education reform. Chapter 3 describes the study methodology.
Chapter 3:
Methodology

Introduction

The ADA, the American Heart Association, and the Dietary Guidelines for Americans Committee all recommend that pregnant women eat 2 to 3 servings (8-12 oz) of fatty fish per week (2, 24, 16). However, many pregnant women receive mixed messages about the safety of fish consumption while pregnant, particularly due to potentially toxic mercury levels found in certain types of fish. Based on previous survey studies regarding fish-eating habits, the researcher hypothesized that knowledge regarding the safety of fish consumption and importance of ω-3 fatty acid supplementation would be lacking, and that the average consumption of fish and conscious use of ω-3 supplements within this sample of pregnant women would fall short of current recommendations.

Research Questions

With this opinion survey, the researcher sought to determine the extent to which these pregnant women perceive fish consumption and ω-3 supplementation as safe and important, as well as how their dietary habits correlated with their beliefs. The researcher also hoped to characterize whether participants’ obstetricians are recommending eating fish or taking an ω-3 fatty acid supplement during pregnancy and how these recommendations impact their patients’ behaviors.
Model of Study Organization

Figure 2 depicts a model of the graphic organization for the study.

This study was approved on December 18, 2009, by the College of Health and Human Services (CHHS) Human Subjects Review Committee (HSRC) of Eastern Michigan University (see Appendix A: CHHS Human Subjects Approval).
Data Collection

It was assumed obstetric clinics are the standard medical care for pregnant women and therefore served as the setting for this study. Obstetric office managers were approached and informed of the purpose of this study. Approval was obtained with Reiter, Hill, Johnson & Nevin, an obstetric and gynecology practice with 14 physicians serving 3 locations in the Washington, DC metropolitan area (see Appendix B: Office Participation Agreement).

The survey was first launched with the downtown Washington DC office to test for any changes before launching at the other 2 locations. The Falls Church, VA, and Chevy Chase, MD, offices were launched 3 weeks later, along with an online format. Each office was provided with 150 copies of the 1-page, 10-question survey as well as a description of informed consent and a pre-stamped and addressed envelope for submission (see Appendix C: Instrument for Data Collection).

Questionnaires were placed in display cases in the waiting room where space permitted. Receptionists were asked to mention the survey to pregnant women as they signed in for their appointments. Surveys were not distributed to each woman but were taken at will by those interested in participating. Patients were informed the survey was part of a graduate study regarding the dietary habits of pregnant women. They were also informed of the goal: to improve the quality of advice given to pregnant women; however, in order to prevent participant bias, the exact purpose and hypothesis were not disclosed.

The questionnaire clearly stated that participation would be voluntary and that anonymity would be assured as no names or personal information would be collected. Informed consent was therefore assumed by anyone who participated. To ensure anonymity, the surveys were to be mailed using the provided pre-stamped and addressed envelope. The
offices also permitted the utilization of a secure drop box for alternate survey collection. No one was able to access the sealed box until the completion of the collection period.

It was assumed that between the time of office approval and the time of data collection – a period of no more than 2 months – potential survey participants would not have visited their doctor. This assumption means that there was little chance for the doctors’ conscious or subconscious recommendations to influence the patients’ perceptions before their participation in the survey.

In order to increase participation, an online survey was also made available through SurveyMonkey™ (29). This survey was advertised on bulletins at local coffee shops and grocery stores. The same informed consent was provided.

Analysis

During the 2 month data collection period, a total of 104 surveys were obtained from 3 obstetric offices and through SurveyMonkey™. Data were analyzed using SurveyMonkey™ software (29) and Microsoft Office Excel software program (30). Descriptive statistics were generated on multiple parameters to characterize the results. Pivot tables were generated to illustrate the relationship between variables. Of interest, the researcher ran bivariate pivot analyses on 1) consumption of the recommended servings of fish and ω-3 supplementation, 2) perceived ability to identify high-mercury fish and actual ability to do so, and 3) presence or absence of a doctor’s recommendation and fish consumption or ω-3 supplementation.
Summary

In summary, the researcher tested the hypotheses that knowledge regarding the safety of fish consumption and importance of ω-3 fatty acid supplementation would be lacking and that the average consumption of fish and conscious use of ω-3 supplements within this sample of pregnant women would fall short of current recommendations by conducting a 10-question survey on said attitudes and behaviors. The findings of this study were used to illustrate the overall perceptions of the safety and importance of fish consumption and ω-3 supplementation during pregnancy. While there were limitations to the study which will be addressed, these results help to illustrate the awareness pregnant women have regarding including a rich source of preformed EPA and DHA in their diet as well as their likelihood for choosing such practices.
Chapter 4:
Results, Analysis, and Discussion

Introduction

In an effort to characterize the beliefs and behaviors of pregnant women, a 10-question paper survey was launched in paper format at 3 obstetric offices as well as in an online format advertised in the region. After the 2-month collection period, 104 surveys were collected, compiled, and analyzed using general descriptive statistics and bivariate pivot tables. In this section, individual survey questions are addressed. Any potential relationships that exist among answers are explored. While specific study limitations were identified, trends in the data were obvious. The implications of these findings are discussed with regard to public health and future research.

Overview of Findings

Briefly, these results revealed that the majority of women believed fish is good for their health during pregnancy; yet a notable portion believed fish is bad for their health. Most of these women are consuming less than the recommended 2-3 servings of fish per week; however, a large majority of those not consuming enough fish did report taking a daily ω-3 supplement. Most women did not receive a recommendation from their doctor to eat fish or take an ω-3 supplement, yet chose to do so. These results suggest that many women are consulting resources other than their doctors for advice and information on prenatal care. In addition, of those who received advice from their doctors, almost all were following that
advice and acquiring ω-3s via fish consumption or supplementation. However, over half of those who did not receive advice were not acquiring ω-3s from either of these sources.

While many women were able to correctly identify those fish generally considered to be high in mercury, there was still a high level of confusion. For instance, many women believed that tuna and salmon are high mercury-containing fish. This confusion is indicated by the fact that most of these women are consuming less fish than recommended and choosing supplements instead.

**Demographics and Response Rate**

Of the 150 surveys provided at each doctor’s office (450 total surveys), only 44 were submitted for a 9.8% response rate. However, it is unknown how many pregnant women visited the office during the collection period. It is also unknown how many women noticed or were introduced to the survey. This rate, therefore, assumes that at least 150 women visited the office and were exposed to the survey. An additional 60 responses were collected with SurveyMonkey™. No rate could be determined, as the number of women exposed to the survey posters is unknown.

**Detailed Analysis**

*Question 1: On average, how many times per week do you eat fish, if at all?*

Figure 3 displays average weekly fish consumption reported by the 104 survey participants. The majority of women (61%, n=63) chose the response “1 or less” servings per week. In order to characterize this trend simply, Figure 4 shows the percentage of women consuming at least the recommended 2-3 servings per week versus those who
consumed less than recommended. As this pie chart clearly displays, the majority of women in this study (82%, n=85) are consuming less than the recommended servings of fish per week.

These results resemble findings of earlier studies. The national opinion survey published by the CFNAP (2006) found that just over one third (36%) of Americans reported eating fish/shellfish once a week or more (3). This study, however, was conducted on all Americans, not exclusively pregnant women. The 2003 survey conducted by Oken et al. following the January 2001 federal advisory found that only 11% of pregnant women surveyed were consuming more than 3 servings of fish per week. Unfortunately, this study did not provide data on those women consuming the recommended 2-3 servings per week (4).

Figure 3. Average number of servings of fish consumed per week. Categories on the x axis represent the average number of fish servings consumed per week. Bars indicate the percentage of the 104 participants who chose each category.
Figure 4. Percentage of women consuming the recommended 2-3 servings, or more, of fish per week. To simplify this relationship, participants who chose “2-3,” “3-4,” and “5 or more” were combined to create a single category, “2 or more,” which represents those who consumed at least the recommended servings of fish per week.

**Question 2: During pregnancy, how would you describe your attitude about eating fish?**

Figure 5 illustrates the distribution of responses regarding attitudes toward fish consumption during pregnancy. The majority (61%, n=62) reported to “avoid only certain kinds of fish.” The other responses, “I don’t like fish or shellfish, so I don’t eat it,” “I try to avoid fish for health reasons,” and “I eat all kinds of fish,” had a roughly even distribution.

Figure 5. Attitudes regarding fish consumption. Categories represent participant attitudes regarding fish consumption during pregnancy. Bars indicate the percentage of the 104 participants who chose each category.
Those who reported avoiding only certain kinds of fish were asked to list the fish they avoid. Figure 6 shows that the most frequent answers were tuna, swordfish, and mackerel. Tuna, in general, is not considered to be particularly high in mercury (31). While albacore tuna is considered to be higher in mercury than chunk light tuna, only 1 participant specified albacore tuna. The 2003 survey by Oken et al. found a decrease in tuna consumption following the 2001 federal advisory (4). These results may indicate some existing confusion among the public as to which fish are safe to eat.

![Figure 6. Most frequently avoided fish.](image)

Question 3: During pregnancy, would you consider fish to be good or bad for your health?

Figure 7 shows that the majority of the women (83%, n=85) stated that they believe fish to be good for their health during pregnancy. This left 17% (n=18) who said they consider it to be bad.
In the 2009 study by Burger and Gochfeld, they reported 94% of their respondents believed there were benefits to fish consumption (28). It is promising that most of the women in the current survey see fish as a healthy part of the diet during pregnancy. The results of this question may indicate that these women are not over-compensating their behaviors due to media messages that warn against the dangers of some high-mercury fish; it appears they understand that at least some types of fish are healthy during pregnancy.

Question 4: During pregnancy, how many servings of fish do you think are allowed or recommended per week?

Interestingly, over 63% (n=65) correctly identified “2-3” or “3-4” servings to be recommended or allowed during pregnancy. Nearly one third (30%, n=31) believed only “1 or less” and 5% (n=5) thought “5 or more” servings were recommended or allowed. These results, shown in Figure 8, suggest that while most of these women are well-informed on the recommendations, there is still a large portion who could be better informed. Unfortunately, previous studies have not addressed this question.
Figure 8. Participant perceptions of the recommended number of servings of fish per week.

**Question 5: Do you believe harmful amounts of mercury exist in certain types of fish?**

Figure 9 helps illustrate the beliefs participants had regarding the effects of mercury in some fish. Of those participants who answered this question, 98% (n=100) said they believed harmful amounts of mercury exist in certain types of fish. These results suggest that public advisories have been effective in conveying the dangers of consuming some types of fish during pregnancy. Again, the fact that the majority still believe fish is good for health during pregnancy indicates that these women understand not all fish are considered dangerous.

While previous studies have focused only on Americans and not pregnant Americans, their results indicate a growing concern about mercury contamination of fish. The 2005 national opinion survey found that 31% of the public reported being concerned about the amount of mercury in fish (3). In the 2009 survey by Burger and Gochfeld, 70% of participants knew about health risks from eating fish, and mercury was the main risk participants mentioned (28).
Figure 9. Percentage of participants who believe certain types of fish contain harmful amounts of mercury.

**Question 6: If asked, could you identify which fish and shellfish are higher in mercury?**

As shown in Figure 10, nearly 70% (n=71) thought they could correctly identify which fish are considered to be higher in mercury. These results indicate that these women are generally confident that they are well-educated about those fish considered to be high-mercury. These findings contrast the 2005 survey conducted by the CFNAP. While this survey focused on all Americans and not pregnant women specifically, 68% of the participants stated they did *not* know which fish were considered high-mercury (3).

Figure 10. Percentage of participants who believed they could identify those fish considered to be high-mercury.
**Question 7: Please check off all fish that you believe are high in mercury.**

Figure 11 shows that the majority of the participants correctly identified those fish that are commonly included in public advisories as high-mercury fish. Over 90% (n=86) chose swordfish, 83% (n=80) chose shark, and 68% (n=65) chose king mackerel.

Compared to previous studies, these results look promising. In the national survey, only 4% of participants identified swordfish, and less than 1% identified shark and king mackerel as high-mercury fish (3). However, it is important to remember that these studies were conducted on Americans in general and not specifically on pregnant women. Expectant mothers fall into the high-risk group and, as such, are ideally given more detailed information.

Figure 11. Perceived high-mercury fish. Participants were asked to choose which fish they believed were high in mercury. King mackerel, shark, and swordfish are commonly included in public advisories as high-mercury fish.

Figure 12 represents a bivariate pivot analysis characterizing how accurately women are able to identify all 3 of the fish known to be higher in mercury. Of those attempting this question (n=96), 32% (n=33) were able to correctly identify the 3 fish highest in mercury.
without giving any incorrect answers. Another 18% (n=19) were able to correctly identify the 3 while including only 1 additional incorrect answer, and 13% (n=14) identified 2 correct answers and only 1 incorrect answer. These results indicate that 70% (n=73) of the participants could correctly identify at least 2 of the high-mercury fish with no more than 1 incorrect answer.

Figure 12. Participants’ ability to identify high-mercury fish. The x axis is broken down into categories according to the number of correct answers given. Each category is further broken down to characterize the number of incorrect responses, represented by different colors. For example, about 33 women identified 3 correct answers and 0 incorrect answers, as shown by the highest peak, in blue. The 4 highest peaks indicated by the arrows represent the percentage of women who could identify at least 2 correct answers and no more than 1 incorrect answer.

It is promising that a large portion of the women were able to identify at least 2 of the high-mercury fish with no more than 1 incorrect answer. However, further analysis of the answers reveals that of those who believed they could identify which fish are higher in mercury (n=71), only 46% (n=33) were 100% accurate in their responses. Also, of the 100 participants who believe harmful amounts of mercury exist in certain types of fish, only one third (33%, n=33) were 100% correct in their responses. Nearly 8% (n=8) of women skipped this question entirely. These results suggest that at least 30% (n=31) of the women still
appear confused about which fish are safe with regard to mercury content and which are not. This may suggest that pregnant women are aware of the risks of mercury in fish, but that there is varied knowledge as to which fish actually present high levels of mercury.

It is also worth noting that many women selected even those fish which are generally considered to be low in mercury, including tuna and salmon, both popular American foods. Figure 11 reveals that nearly 40% (n=37) believed chunk light tuna to be high in mercury. Over 17% (n=17) believed salmon and 20% (n=19) believed catfish to be high in mercury. These results resemble those of the national survey, in which 32% of participants identified tuna, salmon, and shrimp as high-mercury fish/shellfish (3). This further highlights the need to clarify public advice regarding which fish are safe to eat.

**Question 8: Do you currently take a daily fish oil or DHA+EPA (omega-3 fatty acid) supplement?**

Figure 13 shows that the majority of the participants (61%, n=63) reported they are taking a daily fish oil or DHA+EPA (ω-3 fatty acid) supplement.

![Pie Chart](image.png)

**Figure 13. Percentage of participants taking a daily fish oil or DHA/EPA supplement.**
The researcher ran a bivariate analysis to characterize how fish consumption, or lack thereof, affected women’s conscious decision to take an ω-3 supplement. Figure 14 shows that of those who are not eating at least the recommended 2-3 servings of fish per week (n=85), more than half (59%, n=50) are consciously taking an ω-3 supplement. Of the much smaller number of women (13%, n=19) who reported consuming at least the recommended 2-3 servings of fish per week, 74% (n=14) reported they are also taking a supplement. These results are somewhat encouraging. While most women do not eat the recommended servings of fish per week, a good portion are consciously taking a supplement, presumably for the perceived benefits.

Figure 14. Supplement vs. weekly fish consumption. This bivariate pivot analysis characterizes the relationship between fish-eating and supplement-taking. The x axis is divided into 2 groups: those who eat at least the recommended amount of fish (“2 or more”), and those who do not (“1 or less”). The axis is further divided into categories where “No” indicates no daily ω-3 supplement and “Yes” indicates daily ω-3 supplementation. The bars exhibit the percentage of women who take a supplement within each group.

Figure 15 characterizes the percentage of women who are consciously ingesting at least 1 source of ω-3 fatty acids, either via fish consumption or ω-3 supplementation. Two thirds (66%, n=69) of the women are receiving at least 1 source of ω-3 fatty acids.
Question 9: Do you know how much DHA you should be obtaining in your diet each day?

Over 93% (n=94) of the women do not know how much DHA they should be obtaining in their diet each day. These results are not surprising given the lack of informational standards and clear guidelines for pregnant women. Unfortunately, previous studies have not assessed knowledge regarding ω-3 supplementation among pregnant women.

Question 10: Has your doctor ever recommended eating fish or taking an omega-3 fatty acid (DHA/EPA) supplement during pregnancy?

As shown in Figure 16, the majority of women (60%, n=62) stated that their doctors had never recommended eating fish or taking an ω-3 fatty acid (DHA/EPA) supplement during pregnancy. Figure 17 shows that of the women receiving doctor recommendations (n=42), 19% (n=8) are eating at least the recommended amount of fish; whereas of those who did not receive a recommendation (n=62), 18% (n=11) are eating at least the recommended amount of fish.

Figure 15. Percentage of participants consciously taking at least 1 source of ω-3 fatty acids. Participants who either take a supplement or eat at least the recommended amount of fish were considered to be receiving at least 1 source of ω-3 fatty acids.
amount of fish. These results suggest that women are consuming less than the recommended servings of fish per week regardless of doctor recommendations.

![Figure 16](image1.png)

Figure 16. Percentage of participants who received a doctor recommendation for eating fish or taking an ω-3 fatty acid (DHA/EPA) supplement during pregnancy.

![Figure 17](image2.png)

Figure 17. Weekly fish consumption following doctor recommendation. This bivariate pivot analysis characterizes the relationship between doctor recommendations and fish consumption. The x axis is divided into 2 groups: women whose doctors recommended they eat fish or take a supplement and women whose doctors did not provide recommendations. The bars exhibit the percentage of women who do or do not eat at least the recommended servings of fish per week (“2 or more” or “1 or less,” respectively).

Interestingly, Figure 18 reveals that of the women who received a recommendation from their doctor (n=42), a huge majority (>90%, n=38) are taking a supplement as recommended. Of the women who did not receive a recommendation from their doctor (n=62), a smaller percentage (42%, n=26) are taking a supplement. This suggests that the
women listen to their doctor’s advice regarding ω-3 fatty acid supplements when offered. While most may not be eating at least the recommended amount of fish, even when their doctor offers advice, many are consciously taking a supplemental source of ω-3s.

![Figure 18. Supplementation following doctor recommendation. This bivariate pivot analysis characterizes the relationship between doctor recommendations and supplementation. The x axis is divided into 2 groups: women whose doctors recommended they eat fish or take a supplement and women whose doctors did not provide recommendations. The bars exhibit the percentage of women who do or do not take a daily ω-3 supplement.](image)

The researcher also grouped those women who are either eating at least the recommended amount of fish or taking a supplement together to represent those women who are consciously obtaining ω-3 from at least 1 source. Bivariate pivot analysis was again used to illustrate how these behaviors are associated with doctors’ advice. Figure 19a illustrates that of the women with a recommendation from their doctor (n=42), the vast majority (93%, n=39) are consciously obtaining ω-3 from at least 1 source. Figure 19b illustrates that of the women without a recommendation from their doctor (n=62), less than half (48%, n=30) are consciously obtaining ω-3 from at least 1 source. These results show that these women are almost always listening to their doctors’ advice when it’s offered. Many of them, however,
are choosing to eat fish or take an ω-3 supplement on their own, perhaps using outside sources of knowledge and advice.

**Yes, doctor recommendation**

- 93% Yes, omega-3 intake
- 7% No omega-3 intake

Figure 19a. Percentage of participants with a doctor recommendation with some ω-3 intake.

**No doctor recommendation**

- 52% Yes, omega-3 intake
- 48% No omega-3 intake

Figure 19b. Percentage of participants without a doctor recommendation with some ω-3 intake. These bivariate pivot analyses characterize the relationship between doctor recommendations and either recommended fish consumption or ω-3 supplementation.

**Summary**

These results have revealed several trends that may help characterize the dietary climate of ω-3 intake during pregnancy. Overall, these women feel that fish consumption is healthy during pregnancy. Most are aware that 2-3 servings of fish are recommended per week, but most are consuming less than this recommendation. However, the majority of those who choose not to consume the recommended amount of fish are instead supplementing with a source of daily fish oil or DHA+EPA.
The women in this sample also understand that some fish contain potentially toxic levels of mercury, and they are mostly able to identify those fish generally thought to contain the highest levels. However, as previous studies suggested, they were still somewhat confused about the safety of those fish generally considered to be lower in mercury. This suggests that while the overall message warning expectant mothers to be conscious of their fish consumption is effectively being relayed, the details of the message are not being interpreted accurately.

Given that these women are not changing their fish consumption habits in accordance with doctor recommendations when offered, asking doctors to recommend fish consumption does not seem to be an effective method of ensuring ω-3 intake during pregnancy. Contrastingly, when doctors provide recommendations for ω-3 intake, a much larger percentage of the women seemed to take the advice. These results suggest that rather than recommending fish consumption, recommending a specific ω-3 supplement – whether through a prenatal vitamin or other dedicated source – may be a more effective approach to ensuring pregnant mothers are including a source of ω-3 fatty acids in their daily regime.
Chapter 5:  
Conclusion and Recommendations for Future Research

Conclusion

This survey suggests that an interesting dynamic exists between doctors’ advice, or lack thereof, and chosen behaviors of expectant mothers. While small in scale and not without limitations, this analysis identified several strong trends in the data which help to characterize the perceptions and behaviors of fish and ω-3 intake during pregnancy.

There are 3 main takeaways from this analysis. First, the majority of the women surveyed reported that their doctors never recommended eating fish or taking a DHA/EPA supplement, highlighting a need for better informational standards. Second, many consume less than the recommended 2-3 servings of fish per week and are apparently confused as to which fish are considered low-mercury. However, third, many women choose to take a supplement despite the lack of a doctor’s recommendation, which suggests they base their decisions on other factors.

Practical Implications

This survey has helped to characterize the overall dietary climate surrounding ω-3 fatty acids during pregnancy in a small sample of women in the Washington DC area. These findings can be used to highlight several areas where change may be warranted. First, public advisories should emphasize the importance of ω-3 fatty acids in the diet, perhaps citing specific infant development roles to illustrate the role of ω-3s. Namely, the importance of obtaining a source of ω-3 of some kind should be reinforced.
Also, the messages relayed by public health advisories should be improved to increase the percentage of women who accurately interpret the message with clear takeaways. Stressing which fish are considered safe and healthy to eat may help eliminate confusion with, for example, the types of tuna that can be safely eaten. Diverse forms of media should be used to increase the likelihood of the message reaching various cultural groups, education levels, and income brackets.

Finally, the information patients receive from their doctors should be standardized. While doctors should maintain their right to form their own opinions, women should at the very least be informed of their need for ω-3 fatty acids during pregnancy and lactation. The importance of obtaining adequate EPA and DHA during the perinatal period is well supported. The results of this study suggest many women may not be exposed to or aware of the importance of this dietary nutrient. While a sizable percentage of expectant mothers may discover this importance on their own through outside sources of information, doctors should be more proactive in advising patients – whether to eat fatty fish or to take an ω-3 supplement. As the evidence supporting the importance of ω-3 during pregnancy and lactation continues to develop, more widespread standards of practice should be established to ensure that women are obtaining the information from a consistent, reliable source.

As mercury contamination in fish is a clear concern, women should be informed that there are specific, alternative ways of acquiring ω-3 fatty acids in the diet. As this survey supports, many women trust and follow the advice of their doctors when offered; some will seek out information on their own when the advice is lacking; but all women should have access to a reliable source of information. The researcher suggests this source be the doctor.
and therefore recommends that further studies help build the case to encourage standardization of information offered during office visits.

**Limitations of Study**

While this study is helpful in characterizing the beliefs and behaviors of these women, the researcher recognizes several limitations pertaining to the survey sample, instrument, and method of implementation.

**Sample.** There are 3 main limitations of the sample used. First, the information obtained with this sample cannot be extrapolated to any specific population. With only 104 participants, this sample is not large enough or sufficiently diverse to make statistically significant inferences on any population of pregnant women.

Furthermore, there were no personal questions asked of the participants regarding socioeconomic status (SES), education level, home address, age, race, or anything used to create a profile. While it may be assumed that the samples are representative of expectant mothers who visit their doctors, it cannot be assumed that those who filled out the online survey visited a doctor. Fifty-eight percent (n=60) of the samples came from untraceable online responses. Of this portion, it is not possible to identify who filled out the survey or whether they see a doctor.

Next, and along the same lines, this study may not be representative of those falling in lower income levels who may be using federally funded clinics for their healthcare. It is assumed that most of the women filling out the office surveys were
wealthy enough or of high enough SES to be able to afford health insurance or private pay as this is required of patients at these offices.

Finally, the proximity of the office locations means that little can be learned by dividing the samples into regions. A total of 42% (n=44) of the surveys were obtained from obstetric offices: 19% (n=20) from Chevy Chase, MD; 14% (n=15) from Washington, DC; and <9% (n=9) from Falls Church, VA. While each of these areas may be inhabited by a specific, majority resident demographic, it would be neither appropriate nor wise to assume that the patients visiting these offices fall into the local dominant resident profile. All 3 of these offices are easily accessible by car, metro, or bus within 30 minutes driving time; therefore, women from all over the region are equally likely to visit these offices.

**Instrument.** The researcher also recognizes 3 limitations of the instrument used. First, the terminology used in the questions inquiring about servings of fish is unspecific. The term “servings” was not specified to represent a certain weight or portion size of fish. Also, the options “2-3” and “3-4” both contain the choice of “3” and could therefore have been equally chosen by those women consuming the maximum recommended amount of 3 servings per week. In order to minimize the possibility of confusion regarding serving size and response ambiguity, these choices were combined to represent a “2-4 servings” per week category.

It is also important to note that this question does not specify types of fish. The recommendation is to eat 2-3 servings of fatty fish per week. As such, this question is unable to characterize whether or not women are consuming fish high in
ω-3 fatty acids. However, the purpose was to characterize the attitudes about fish in general, and it was felt that adding words such as “fatty” or “cold water” would have complicated the responses as women use different approaches for identifying with those fish perceived to be healthy and high in ω-3 fatty acids.

Second, it may have been wise to include a question regarding the specific brand of prenatal vitamin prescribed and/or chosen in order to estimate the amount of ω-3 fatty acids being ingested unknowingly by the women. Standard prenatal vitamins do not contain ω-3 fatty acids (31). While some doctors recommend brands that contain DHA/EPA, others do not specify brands, and still others recommend those that do not contain DHA/EPA. However, this study was focused on women’s perceptions and behaviors regarding fish and fish oil and was not meant to determine exactly how much ω-3 a woman is ingesting. There are clearly other sources of ω-3 such as walnuts and flax seed which were not considered in the survey.

Finally, while this survey characterizes the relationship between doctor recommendations and ω-3 intake whether from fish consumption or supplementation, it is not possible to ascertain what specific advice the women are receiving. Question 10 asks if the participant’s doctor recommended either consuming fish or taking a supplement, so it is possible that some doctors are recommending patients avoid fish but take a supplement. However, for the purposes of this study, the source is irrelevant; the main concern is only that women are acquiring a source of ω-3s.

**Method of implementation.** The researcher further recognizes the limitation of having a voluntarily completed survey. Due to time constraints of office personnel, it
was not possible to arrange for every pregnant patient to be personally given a survey. It is believed that those who completed surveys chose to do so because of some interest in or knowledge of the subject (32). Had the surveys been handed to each pregnant patient, participation rates may have increased, thereby decreasing the chance for participant bias.

It is possible that those who took the online survey may have been more inclined to do some self-led, online research before choosing their answers. This could have swayed the number who correctly identified the recommended 2-3 servings of fish per week or those fish commonly known to contain the highest levels of mercury. However, there was not a strong difference in the distribution of answers amongst sites or methods of survey completion to suggest a bias from using the online format. In fact, the only question with notable difference in answers was that which asked if women believed they could correctly identify which fish and shellfish are higher in mercury, and, surprisingly, those who filled out the survey in the doctor's offices were more confident than those who filled out the online format (82% versus 60%).

**Recommendations for Future Research**

Given the strong trends in this research, future studies should attempt to further characterize these findings. Larger studies that draw data from a range of geographic and socioeconomic samples would help to identify shortcomings in both information about and access to sources of DHA/EPA.
This study sought to characterize $\omega$-3 intake from obvious sources: fish and EPA/DHA supplements. Future studies should seek to determine how much $\omega$-3 women are obtaining from all sources. It has become a common practice for obstetricians to recommend that women take prenatal vitamins during the perinatal period. However, there are numerous preparations on the market with varying ingredients and dosages (31). Furthermore, the practice of recommending a prenatal with DHA is not standard, and it is up to the discretion of the doctor to make such recommendations. Given these inconsistencies, pregnant women may or may not be obtaining sufficient $\omega$-3 fatty acids in their prenatal vitamins. Future studies should consider this variable, asking the specific brand used and analyzing them for content.

More research is also needed to determine the accessibility to sources of information such as an obstetrician, informational pamphlets, books, and Internet access. In addition, a survey of physicians and their opinions regarding fish and $\omega$-3 supplementation during pregnancy might help to characterize the overall style of practice. For instance, it would be helpful to know if doctors are recommending their patients avoid fish, if they’re specific about the types of fish to avoid, or if they’re only focusing on supplements.

Finally, future studies should strive to characterize women’s access to sources of $\omega$-3-rich sources of fish or supplements, including affordability. These questions should be extended to a varied population in order to determine where gaps in information and access may exist.
REFERENCES


APPENDICES
Appendix A: CHHS Human Subjects Approval

December 18, 2009

Jessica Ess
c/o Judith Brooks
Eastern Michigan University
School of Health Science
Ypsilanti, Michigan 48197

Dear Jessica Ess,

The CHHS Human Subjects Review Committee has reviewed the revisions to your proposal entitled: “Current Perceptions Regarding the Importance and Safety of Fish Consumption and Omega-3 Fatty Acid Supplementation Among Pregnant Women” (CHHS 10-001).

The committee reviewed your proposal and its revisions and concluded that the risk to participants is minimal. Your study is approved by the committee.

Good luck in your research endeavors.

Sincerely,

[Signature Removed]

George Liepa, Ph.D.
Chair, CHHS Human Subjects Review Committee
Appendix B: Office Participation Agreement

October 13, 2009

George Liepa, Ph.D.
Chair, CHHS Human Subjects Review Committee
206 Marshall Building
Ypsilanti, Michigan 48197

Dear Dr. Liepa,

This letter is to confirm agreement to host the graduate survey study to be conducted in the upcoming months by Jessica Ess. We agree to host the study at each of our three clinics, provided that the researcher includes stamped envelopes for patients to mail questionnaires outside of the office.

Sincerely,

[Signature Removed]

Jo Wodiska
Practice Administrator
Appendix C: Instrument for Data Collection

Are you eating FISH ???

**Please complete this questionnaire only if you are pregnant**

Hello, my name is Jessica Ess and I am a dietetic graduate student with the Eastern Michigan University Dietetics and Human Nutrition Program. I am trying to gather information on the eating behaviors of pregnant women in order to improve the advice professionals provide for you. This is a graduate research project. Your participation is voluntary and anonymous. If you choose to participate, you will be asked to complete the attached survey consisting of ten questions. The survey will take less than 10 minutes to complete. Your confidentiality will be protected to the greatest extent possible.

Upon completion, please slip the survey into the provided drop box or mail it in the envelope provided. Please do not include your name or any personal information on this survey. If you have any questions about how you are eating, please ask your doctor during your appointment. Participants will not see their survey results. Results of this research will be included in a graduate thesis and will be submitted for poster presentation at a professional meeting and for publication in professional journals. Because the researcher will not be able to identify survey participants based on survey responses the confidentiality of survey participants during the dissemination of research results is insured.

This study poses no foreseeable risks, benefits or discomforts for study participants. Your participation is completely voluntary, you may choose to withdraw from the study at any time without penalty or negative impact. There will be no cost to you or compensation for participating in this study.

By completing this survey you acknowledge you have been informed of, and understand, the nature and purpose of this survey, and that you freely consent to participate.

This research protocol and informed consent document has been reviewed and approved by the Eastern Michigan University CHHS Human Subjects Review Committee for use from December 18, 2009 to December 17, 2010. If you have any questions about the approval process, please contact Dr. Judith Brooks, Thesis Chair (734-487-3221, judi.brooks@emich.edu) or Dr. George Liepa, Chair of CHHS Human Subjects Review Committee (734-487-2499, chhs_human_subjects@emich.edu).
1. On average, how many times per week do you eat fish, if at all?

- None
- 1 or less
- 2-3
- 3-4
- 5 or more

2. During pregnancy, how would you describe your attitude about eating fish?

- I don’t like fish or shellfish, so I don’t eat it
- I try to avoid fish for health reasons
- I eat all kinds of fish
- I avoid only certain kinds of fish. If so, please list_______________

3. During pregnancy, would you consider fish to be good or bad for your health?

- Good
- Bad

4. During pregnancy, how many servings of fish do you think are allowed or recommended per week?

- None
- 1 or less
- 2-3
- 3-4
- 5 or more

5. Do you believe harmful amounts of mercury exist in certain types of fish?

- no
- yes

6. If asked, could you identify which fish and shellfish are higher in mercury?

- no
- yes

7. Please check off all fish that you believe are high in mercury.

- swordfish
- salmon
- shark
- chunk light tuna
- king mackerel
- catfish

8. Do you currently take a daily fish oil or DHA+EPA (omega-3 fatty acid) supplement?

- no
- yes: dosage if known_____________

9. Do you know how much DHA you should be obtaining in your diet each day?

- no
- yes: dosage if known_____________

10. Has your doctor ever recommended eating fish or taking an omega-3 fatty acid (DHA/EPA) supplement during pregnancy?

- no
- yes
Appendix D: Study Summary – Proposal for Office Participation

Overview: a survey study on the dietary opinions and habits of pregnant women.

Purpose: to determine the opinions of pregnant women regarding the nutritional value of various foods and to analyze how their dietary habits compare to these opinions.

Survey:
- Format: 1 page (5-10 question, multiple-choice & fill-in-the-blank)
- Content: In order to minimize physician bias during visits prior to data collection, the questions listed below are not the actual survey.
- Method: receptionist will include survey with registration forms to be filled out in waiting room prior to office visit. Collection via a small “drop box” or folder at the reception desk.
- Timeframe: collection period of 1-month, starting in September or October 2009 or when study approval is obtained.
- Goal: at least 250 participants representing 3 offices

Additional Information: It is presumed that the survey itself may promote related dialogue regarding this topic during the office visit; therefore, prior to the start of the study, doctors will be offered educational materials summarizing current industry recommendations and ongoing research for either their own reference or for dissemination to patients.

Sample survey:

**Please complete this questionnaire only if you are pregnant**

This is a graduate survey study of nutritional habits and opinions. Your participation is voluntary and anonymous. Please do not include your name or any personal information on this survey. Upon completion, please return the survey to the drop box at the reception desk.

1.) On average, how many servings of fruit or fruit juices do you consume per DAY?

   __ none    __ 1-2    __ 3-4    __ 4-6    __ 7 or more

   How many servings do you think you SHOULD aim for?___________

2.) On average, how many servings of vegetables do you consume per DAY?

   __ none    __ 1-2    __ 3-4    __ 4-6    __ 7 or more

   How many servings do you think you SHOULD aim for?___________
3.) On average, how many servings of red meat do you consume per WEEK?
__ none  __ 1-2  __ 3-4  __ 4-6  __ 7 or more
How many servings do you think you SHOULD aim for?__________

4.) On average, how many servings of milk/cheese/yogurt do you consume per
DAY?
__ none  __ 1-2  __ 3-4  __ 4-6  __ 7 or more
How many servings do you think you SHOULD aim for?__________

5.) How many servings of caffeinated drinks do you consume each DAY? (1
serving= 1 cup)
__ none  __ 1-2  __ 3-4  __ 4-6  __ 7 or more
How many servings do you think you SHOULD aim for?__________

6.) Do you take any dietary supplements? Please mark all that apply.
__ none  __ multivitamin  __ calcium
__ folic acid  __ others