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IN FOCUS

Dietary Intake and Omega-3 DHA Status in Pregnant Women Who Are Overweight

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ABSTRACT

Objective: To estimate dietary intake of pregnant women who are overweight, assess their omega-3 docosahexaenoic acid (DHA) status, and compare results between Black and White women.

Design: Cross-sectional study with a longitudinal component (dietary assessment).

Setting: Outpatient clinics at Woman's Hospital, Baton Rouge, Louisiana and telephone calls.

Participants: Pregnant women ($N = 21$) who were overweight (body mass index = 25.0–29.9 kg/m^2).

Methods: Repeated 24-hour dietary recalls using the University of Minnesota Nutrition Data System for Research were conducted to determine nutrient intakes. Red blood cell fatty acids were analyzed with gas chromatography to determine omega-3 DHA status. Descriptive statistics, one- and two-sample *t* tests, Fisher's exact tests, chi-square test, and analysis of covariance were used to analyze data.

Results: On average, participants consumed 72 ± 63 mg omega-3 DHA/day. Age, race, and socioeconomic status did not affect the probability of achieving recommended omega-3 DHA dietary intake ($p > .05$). Black women had lower omega-3 DHA status (7.98 ± 0.94 weight percentage) than White women (9.29 ± 1.68 weight percentage; $p \le .05$).

Conclusion: Analysis of our data suggests a need for nutrition education regarding the benefits of omega-3 DHA consumption during pregnancy for women of childbearing age. The current finding warrants further exploration.

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AWHONN

Alterations to fetal nutrition and endocrine status during pregnancy can modify fetal physiology and metabolism. As a result, the infant may be predisposed to a host of diseases later in life. This phenomenon is known as the fetal origins hypothesis (Barker, 1995). Pregnancy is considered a critical period in which the long-term regulation of energy balance may be programmed (Reilly et al., 2005), and maternal nutrition during the perinatal period plays a role in fetal development (Haggarty, 2010). Every nutrient affects the long-term health of the infant, and excesses or deficits in consumption can potentially have detrimental effects (Simmons, 2008; Whitaker & Dietz, 1998). Over- or under-nutrition during the perinatal period influences the development of obesity for the infant later in life (Muhlhausler, Gibson, & Makrides, 2010). Courville, Harel, and Lammi-Keefe (2011) showed that omega-3 docosahexaenoic acid (DHA) supplementation during pregnancy can result in leaner infants. Infants born to mothers supplemented with an average of 214 mg/day of omega-3 DHA from 24 weeks of pregnancy until birth were leaner at birth with lower ponderal indexes (a relationship between weight and height that is used to indicate infant body fatness) than infants born to mothers who consumed a placebo. Similarly, Donahue et al. (2011) showed that greater concentrations of omega-3 fatty acids in the maternal diet during pregnancy were associated with lower adiposity in children at 3 years of age. Clearly, the environment in early life plays a significant role in the development of obesity, and fetal programming sets the stage for the development of disease later in life. Maternal nutrition during pregnancy also affects infant cognitive and visual development (Bradbury, 2011; Innis & Friesen, 2008; Judge, Harel, & Lammi-Keefe, 2007a, 2007b).

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Because of the well-known benefits of omega-3 DHA to infant health outcomes, experts from the World Association of Perinatal Medicine, the Early Nutrition Academy, and the Child Health Foundation recommended that pregnant and lactating women should achieve an average daily intake of at least 200 mg/day of omega-3 DHA (Koletzko et al., 2008). Similarly, the U.S. Department of Agriculture and the U.S. Department of Health and Human Services (2015) recommended that pregnant women consume at least 8 and as many as 12 ounces of seafood per week that provide an average of 250 mg/day of omega-3 DHA and eicosapentaenoic acid (EPA) combined; EPA is a precursor to DHA. This recommendation can be attained by eating a variety of seafood, including varieties that are high in omega-3 DHA and EPA but low in methylmercury. Salmon, white tuna (bluefin and albacore), sea bass, trout, and oysters are good sources of omega-3 DHA that contain low amounts of methylmercury; therefore, they are recommended for consumption during pregnancy. Large predatory fish such as shark, swordfish, tilefish, or king mackerel should be avoided because they are more likely to bioaccumulate methylmercury. These fish eat smaller organisms that contain methylmercury, which can be harmful for a developing fetus (Institute of Medicine [IOM], 2007; see Table 1) and can cause adverse effects on infant cognition and child development (Oken & Bellinger, 2008). Given the evidence that omega-3 DHA can benefit predisposition to obesity and infant neurobiological development, the objective of the current study was to estimate dietary intake of pregnant women who are overweight, assess their omega-3 DHA status, and compare results between Black women and White women at midpregnancy.

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Background and Significance

Most lipids (commonly called fats) in our diets are triglycerides, which are composed of a glycerol backbone with three fatty acids attached. These fatty acids may differ in their chemical structure (omega-3 or omega-6) and vary from saturated to polyunsaturated fatty acids and from shorter- to longer-chain fatty acids. Because the omega-3 fatty acids differ from the omega-6 fatty acids in the food sources in which they are found and in their physiological roles and functions, interest has grown with regard to the amount to be consumed and also in the ratio of dietary omega-3 with respect to omega-6 fatty acids (see Figure 1). The ratio of the dietary omega-3 to omega-6 fatty acids is considered important because during metabolism, they share the same enzymes and therefore compete with each other (Simopoulos, 2008). An optimal ratio of omega-3 and omega-6 fatty acids is required in the diet to provide a healthy balance. Recommendations for the ratio of omega-6 to omega-3 vary from 5:1 to 10:1 (Koletzko et al., 2008; Simopoulos, 2002); an optimal ratio has not been established and could vary in different stages of life (IOM, 2005; Ross, 2012).

The long-chain polyunsaturated omega-3 fatty acids found in cold water marine fish (Russo, 2009) include omega-3 DHA and omega-3 EPA. In particular, omega-3 DHA has attracted much interest in the past decade because of its demonstrated importance to pregnancy outcome, infant development, and other health benefits. Humans do not efficiently synthesize the long-chain polyunsaturated fatty acid (LCPUFA) omega-3 DHA from its 18-carbon precursor (α-linolenic acid [ALA, 18:3n-3]), and therefore it must be obtained through the diet. It is thought that humans lost the capacity to synthesize omega-3 DHA during evolution (Barceló-Coblijn & Murphy, 2009).

Benefits of Fatty Acids During Pregnancy

More than 35 years ago, investigation regarding the role of omega-3 and omega-6 LCPUFAs on fetal development emerged. During the past few decades, a number of investigators evaluated fetal tissues at different time points during pregnancy, and the conclusion was the same: fatty acid accretion increases with gestation and reaches its maximum level during the last trimester (Clandinin et al., 1980; Crawford, Williams, Hassam, & Whitehouse, 1976; Martinez, 1992). Omega-6 arachidonic acid (ARA) and omega-3 DHA are the most abundant LCPUFAs in the fetal brain with roles for structure and function (Crawford et al., 1997). Hence, the nutrient needs, especially for omega-6 ARA and omega-3 DHA, increase during pregnancy to provide the fetus with sufficient quantities for adequate growth and development.

Omega-3 DHA is recognized as the most abundant omega-3 fatty acid in cell membranes of the brain and the retina (Larsen, Eilertsen, & Elvevoll, 2011) and plays a key role in fetal brain and retina development (Innis & Friesen, 2008; Judge, Cong, Harel, Courville, & Lammi-Keefe, 2012; Judge et al., 2007a, 2007b; Koletzko et al., 2001; Koletzko, Larque, & Demmelmair, 2007). During the last trimester of pregnancy and throughout

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