# Docosahexaenoic acid level of breast milk of iranian women in low fish – consuming and high fish – consuming regions

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## Abstract

**Objective:**
Sufficient intakes of docosahexaenoic acid (DHA) via breast milk are required for optimizing visual and neural development at early stages of life. Little or no information is available on DHA intakes and levels found in breast milk in Iranian women and surrounding regions. In this study we measure the DHA in the breast milk of lactating Iranian women from low and high – fish-eating regions and estimate their DHA intakes.

**Methods:**
This is a cross-sectional and prospective study done in two cities of Iran (Mashhad and Amol); 10 ml of mature breast milk were obtained from 40 healthy lactating women (selected randomly) at Imam Reza Hospital of Mashhad (a low fish-consuming area) and Amir Kola Children Hospital of Amol city (a high fish-consuming area). The data were analyzed in two samples by using t-independent test and Mann-Whitney test via SPSS version 11.5 software.

**Results:**
The breast milk DHA levels of mothers living in the high fish-consuming area (Amol) were significantly higher than mothers living in the low fish-consuming area (Mashhad, $p< 0.01$). It can be estimated that the average DHA intake of lactating Iranian women is approximately 184 mg/dl in Mashhad and 307 mg/dl in Amol.

**Conclusion:**
The DHA content of breast milk was higher in high-fish consuming area in comparison to the low-fish consuming area in Iran indicating that the DHA levels of breast milk are influenced by fish consumption.

**Keywords:**
Breast milk, Docosahexaenoic acid level, Low and high fish-consuming region

## Introduction

The central nervous system begins to mature during intrauterine life and continues to do so until seven years of age, exhibiting greatest intensity during the first two years of life. The morphogenesis process, which is directly related to cerebral function, requires a supply of specific fatty acids, in particular arachidonic and docosahexaenoic acids (DHA). This means that appropriate maternal nutrition is essential to the fetus during pregnancy and lactation. We know there is increased functional and biochemical demand on maternal long chain polyunsaturated fatty acids (PFA) (1). Omega-3 long-chain fatty acids can be found in the brain and retina and are active in growth processes, contributing to

myelination and visual function development and several behavior-related features of neural function (2). After birth these essential fatty acids are transferred to infants insufficient quantities via breast milk of mothers whose nutritional status is adequate. In developing countries, such as Iran where health and nutrition conditions may be compromised, nutritional deficiencies may result in elongation and desaturation (1). Essential dietary constituents such as vitamins cannot be synthesized endogenously. The dietary essential fatty acids are polyunsaturated fatty acids (PUFAs) that contain the n6 with or without the n3 double bond, neither of which can be synthesized endogenously. The n6 (or ω6) PUFAs contain the n6 double bond, and the n3 (or ω3) PUFAs have both n6 and n3 double bonds. (The n or ω notation refers to the position of the double bond relative to the methyl terminus of the fatty acid molecule.) In fish and fish oils, n3 PUFAs are present as long chain (LC) PUFAs (i.e. 20 and 22 carbon atoms long) C20 and C22 (3). Little information is available on the DHA levels in women from the Middle East including Iran. Studies indicated that the mean breast milk DHA level of Canadian women is 0.14% of total milk fat(4). Also studies show that diet especially fish, had discernible effect on DHA level (5).

On the other hand fish oil consumption by the mother has been shown to increase the breast milk DHA level. We decided to study the DHA level in two regions (high and low fish -consuming) in Iran to assess the effect of fish intake on breast milk DHA level.

## Methods

This cross-sectional and prospective study was done in two different cities of Iran (Mashhad and Amol); 40 healthy lactating women (first month postpartum) were selected randomly in Mashhad a low fish-consuming area and Amol city a high fish-consuming area. The study was approved by the Ethics Committee of Mashhad University. Healthy lactating women with no heart or circulatory diseases, gall bladder diseases, thyroid disorders, hyperlipidemia or liver disorders were selected. Mothers with sore nipples or abscess were excluded from the study. Twenty women from Amol city, Mazandaran province north of Iran (high-fish consuming area) participated in this study, at Amir Kola Children Hospital.

Twenty women from Mashhad, Khorasan Razavi province northeast of Iran (low-fish consuming area) joined in this study, at the Imam Reza Hospital. All milk samples were collected in July 2003; 10 ml of breast milk samples were obtained from each subject and then transferred directly to a sterile tube. All the participants completed a questionnaire asking about their background information, anthropometric information, health condition, breast feeding practices, information about infant and the frequency of fish consumption per week . The milk samples were stored in a freezer at -25℃ until they were transported to the University of Guelph for processing and capillary gas–liquid chromatographic analysis. The data were analyzed by using SPSS version 11.5 software. Then data were compared. The anthropometric data are presented as means± SD. Frequency and mean of data were determined by descriptive statistics. To determine normality of data we used one sample Kolmogorov Smirnov test. If data were in normal distribution independent t-test was used and for non-normal distribution Mann Whitney test was used. The cut-off level for significance was chosen at $p< 0.05$.

## Results

The overall characteristics of the women from the two regions are given in Table 1. There were no significant differences between the two groups with respect to age, weight, height, BMI (body mass index) or duration of lactation at sampling time. Based on interviews, there was a highly significant difference in the number of fish meals consumed per week (0.23 for Mashhad vs. 1.55 for Amol). Table 2 gives the fatty acid composition of breast milk from the two regions. Very similar fatty acid profiles were found between the two groups with respect to individual saturated and monounsaturated fatty acids. With regard to individual n-6 fatty acids, significantly higher levels were found in Amol relative to Mashhad for 20:2, 20:3, 20:4 and 22:5. No significant differences in the total n-3 fatty acid levels were found between the regions. As the results shows the relative levels of individual n-3 fatty acids in the breast milk from the two regions with respect to α-LNA (alpha – linolenic acid) the major n-3 fatty acid in breast milk, no

Table -1.Characterization of the lactating women from the two high and Lowe fish consuming regions in Iran

| Parameter | Mashhad (lowfishregion) Mean ± SD | Amol (high-fish region) Mean ± SD | P. Value |
|---|---|---|---|
| Age ( year ) | 25.90 ± 1.34 | 28.25 ± 1.58 | P<0.001* |
| Weight (kg) | 64.25 ± 3.08 | 71.70 ± 2.90 | P<0.001* |
| Height (m) | 1.56± 2.03 | 1.60 ± 1.81 | P>0.1 |
| BMI (kg/m) | 26.25 ± 1.03 | 27.93 ± 1.07 | P<0.001* |
| Lactation (weeks) | 2.35 ± 0.24 | 2.20 ± 0.21 | P<0.01* |
| Fish mean(s) week | 0.23 ± 0.08 | 1.55 ± 0.17 | P<0.0001 * |

significant differences in levels were found. Also no significant differences were found in the case of 20:4 n- 3 or for EPA (elcosapentaenoic acid). Significant differences were found for the levels of 22:5 n- 3 and DHA (docosahexaenoic acid). In the latter case the mean DHA contents of breast milk in Mashhad and Amol were 0.23± 0.06 % and 0.32± 0.13% of total acids , respectively. In total (n= 40) they had a content of 0.28± 0.11% .

## Discussion

Results showed that the breast milk DHA levels of mothers living in the high fish-consuming areas (Amol) were significantly higher than mothers living in the low fish-consuming areas (p< 0.01). Olafsdottir studied the proportion of polyunsaturated fatty acids (PUFA) in the diet and breast milk of lactating women with traditional fish and cod liver oil consumption under free-living conditions. In his study dietary intake of 77 lactating women were investigated by 24-hour recalls and the breast milk samples were taken. Maternal intake data was calculated and fatty acid pattern from breast milk samples

Table -2. Fatty Acid Compositions of Breast milk for Two Regions ( % of Total )

| Fatty Acid | Mashhad Mean ± SD | Amol Mean ± SD | P. Value |
|---|---|---|---|
| C12:0 | 8.09 ± 0.75 | 8.20 ± 0.56 | P>0.1 |
| C14:0 | 9.25 ± 0.97 | 9.11 ± 0.71 | P>0.1 |
| C18:0 | 21.10 ± 0.5 | 22.40 ± 0.56 | P<0.001* |
| C18:0 | 7.08 ± 0.45 | 6.54 ± 0.36 | P<0.001* |
| C15:l n-7 | 2.87 ± 0.17 | 2.85 ± 0.19 | P>0.1 |
| C15:l n-8 | 34.29 ± 1.10 | 32.66 ± 0.75 | P<0.001* |
| C20:1 | 0.61 ± 0.03 | 0.88 ± 0.03 | P<0.001* |
| C22:1 | 0.19 ± 0.01 | 0.17 ± 0.01 | P<0.025* |
| C19:2 n-6 | 11.16 ± 0.97 | 10.76 ± 0.41 | P<0.05* |
| C18:3 n-6 | 0.14 ± 0.01 | 0.13 ± 0.01 | P<0.005* |
| C20:2 n-6 | 0.34 ± 0.03 | 0.46 ± 0.04 | P<0.001* |
| C20:3 n-6 | 0.39 ± 0.03 | 0.52 ± 0.04 | P<0.001* |
| C20:4 n-6 | 0.52 ± 0.03 | 0.71 ± 0.05 | P<0.001* |
| C22:4 n-6 | 0.13 ± 0.01 | 0.27 ± 0.04 | P<0.001* |
| C22:5 n-6 | 0.7 ± 0.01 | 0.11 ± 0.01 | P<0.0001* |
| Total n-3 | 1.19 ± 0.09 | 1.23 ± 0.05 | P<0.05* |
| Total n-6 | 12.61 ± 0.86 | 13.26 ± 0.53 | P<0.005* |
| Total n-6 / Total n-3 | 10.86 ± 0.55 | 10.84 ± 0.45 | P>0.1 |

were analyzed with gas chromatography. This study showed that women using cod liver oil (n= 18) had a significantly higher total PUFA intake (14 +/- 10 vs. 9 +/- 7 g/day; 5.0 +/- 3.4 vs. 3.9 +/- 3.0 , P< 0.05) than women who did not use it (n = 59). In particular, mothers consuming cod liver oil had higher breast milk proportion of docosahexaenoic acid (DHA, 0.54 vs. 0.30%, p< 0.05). They also had higher breast milk proportions of elcosapentaenoic acid (EPA; 0.16 vs.0.07%; p< 0.05) and docosapentaenoic acid (DPA; 0.22 vs. 0.17%; p< 0.05). Thus, the proportion of PUFA in the diet is significantly higher among women consuming cod liver oil. Its use also gives higher proportion of EPA, DPA and DHA in breast milk without decreasing other important fatty acids, as this may have an impact on the health and development of breast-fed infants in later life (4).

In another study Al-Tamer showed that socioeconomic status of lactating mothers affected the lipid content and FA composition, especially the level of n (3) LCPUFAs (the very important structural constituents of the retina, brain and other nervous tissues). Mature breast- milk for the studied groups was low in n (3) LCPUFAs compared with that of mothers from developed countries and compared to that recommended by WHO for optimum infant nutrition (5).

In our study the DHA levels differences indicated that fish consumption will be a major source of dietary DHA for women in Amol. Compared with milk from various countries, the mean breast milk DHA level of Iranian women (both regions) were considerably higher than that of Canadian women, because the mean DHA levels of Canadian women is 0.14% of total milk fat (6) Based on the results of studies measuring the amount of DHA in breast milk. (3-11) Correlations between DHA intakes and corresponding levels in breast milk, showed the mean DHA intakes of the women from Mashhad and Amol can be estimated. Such calculations estimate the average DHA intakes of these lactating women to be approximately 184 mg/day in Mashhad and 307 mg/day in Amol. Based on ISSFAL recommendations for ensuring 300 mg/day of DHA for lactating women (12) , it is apparent that approximately half the women in Amol are consuming sufficient levels of dietary DHA (with fish being a major source) and a lesser portion of the women from Mashhad meeting such targets . However, the estimated DHA intakes in the Iranian women studied are well above the reported mean intakes of 78 mg/day for North Americans (13). Enhancing DHA intakes from various dietary sources and supplements if necessary to ensure sufficient DHA intakes during lactation is worthy of endorsing via public health recommendations especially in regions such as Mashhad .


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