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DHA supplementation during pregnancy: benefits and risks - review

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Abstract

Pregnancy is a special period in a woman's life that requires special attention. For the proper development of the foetus and the maintenance of the mother's health, a balanced diet and appropriate supplementation are extremely important. One of the key nutrients is docosahexaenoic acid (DHA), which belongs to the group of polyunsaturated omega-3 fatty acids. The present paper reviews the literature on the biological significance of DHA during pregnancy, as well as the sources of this nutrient and its requirement. The benefits of taking DHA are also presented. The potential risks and limitations of DHA supplementation are discussed, including the risks of contaminants present in fish products. International recommendations and future research directions are also presented, highlighting the need for further analysis of the impact of DHA on the long-term health of both mother and child.

Objective:

This thesis aims to review the scientific literature on the biological importance of DHA during pregnancy, the sources and need for this ingredient and the benefits of supplementation. The text will also address the potential risks and limitations of DHA intake, international recommendations, and future research directions in this field.

Materials and methods:

The review includes scientific papers and literature reviews published in the last 15 years 2010-2025, available in the PubMed and Google Scholar databases, which were identified using relevant keywords such as DHA supplementation and pregnancy. Polish and international recommendations were also included in the analysis.

Conclusions:

DHA supplementation during pregnancy is particularly important for the development of the fetal brain and vision, as well as for the prevention of pregnancy complications. However, there is a lack of precise data on optimal doses and desired DHA concentrations in the blood. Future studies should focus on these issues and the long-term effects of DHA supplementation.

Keywords: Supplementation during pregnancy, omega-3 fatty acids, DHA, nutrition during pregnancy, fish, fetal development.

Introduction:

Pregnancy is a unique period in a woman's life, during which her body undergoes numerous physiological, hormonal and emotional changes to ensure optimal conditions for the development of the foetus. A healthy diet plays a key role in this process, which should provide the necessary nutrients to support the normal growth of the baby. A well-balanced diet, often supplemented with supplements, provides substances such as proteins, fats, carbohydrates and micro- and macroelements. These components are necessary for the proper functioning of the placenta, support the development of the foetus and meet the increased metabolic needs of the mother [1]. According to the July 2020 Recommendation of the Polish Society of Gynaecologists and Obstetricians, the basic elements that a pregnant woman should supplement are iron, folic acid, vitamin D, DHA acids (docosahexaenoic acid) and iodine [2]. Of particular importance is DHA acid, which belongs to the group of long-chain polyunsaturated fatty acids

(LPUFAs) [1]. The LPUFA group includes omega-3 and omega-6 fatty acids, which are essential for the human body, as the body cannot synthesise them on its own, so they must be supplied with food [3]. Omega-3 fatty acids include: docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA), alpha-linolenic acid (ALA), while omega-6 fatty acids include: arachidonic acid (AA), linoleic acid (LA), gamma-linolenic acid (GLA) [13,16]. The aforementioned chemical compounds have more than one double bond in their structure and a long carbon chain (usually 20-22 carbon atoms) [4].

Docosahexaenoic acid (DHA) plays a key role in brain function and in the construction of the neuronal membrane. It is essential for the proper development of the myelin sheath, which supports efficient nerve conduction, and for the maturation of the retina, which has an important impact on visual acuity [1]. The PTGiP recommends DHA supplementation of at least 200 mg daily for all pregnant women [2]. For pregnant women who consume low amounts of fish, the recommended dose of DHA should be increased to meet the body's needs [2]. On the other hand, for women at increased risk of preterm birth, a DHA intake of 1000 mg per day is recommended, which may help to reduce the risk of complications associated with preterm birth [2]. In this review, we have summarised the current state of knowledge on the effects of DHA acid supplementation on the foetus and the mother.

Results of the literature review

1. Biological significance of DHA in pregnancy:

Development of the fetal nervous system

DHA is a key component of the phospholipids that make up the membranes of neurons, influencing their elasticity and functionality [2]. During pregnancy, the demand for docosahexaenoic acid increases significantly, especially in the third trimester, when fetal brain development is particularly intensive.

It is worth noting that DHA accounts for approximately 40% of all fatty acids found in the brain. Docosahexaenoic acid plays an important role in the process of myelination of neurons, which is crucial for the efficient transmission of nerve impulses. It also contributes to the modulation of dopaminergic and serotonergic neurotransmission [5]. Additionally, it promotes the protection of nerve cells against oxidative stress and apoptotic death [5]. Despite the numerous benefits of supplementation with this compound, the available studies show quite a few discrepancies in the effects of DHA on fetal neurological development. One study found that higher maternal DHA concentrations were associated with better cognitive test scores in children later in life [2]. It has a beneficial effect on the development of behavioural functions and language abilities of minors [4,6]. Long-term benefits for child development can be seen from a study conducted by Richardson and colleagues. This study showed that daily supplementation with 600 mg of DHA, extracted from microalgae oil, for 16 weeks significantly improved reading skills in children aged six to 10 years. Participants in the study, who initially had lower scores compared to their peers, achieved better results after supplementation [7].

In contrast, in a randomised controlled trial, Makrides et al. investigated whether taking DHA in the second half of pregnancy has an effect on improving neurological outcomes in children. They found that the use of DHA-rich fish oil capsules, compared to vegetable oil capsules, did not benefit cognitive and language development in early childhood [8]. Studies also suggest that DHA supplementation may reduce the risk of autism spectrum disorders or ADHD [4]. Although DHA supplementation has been shown to have many benefits for both mothers and their children, there are important gaps in clinical research regarding its effects on fetal neurological development. This issue certainly deserves further analysis in future studies.

Visual development

Docosahexaenoic acid (DHA) is an essential component of the retina, especially the photoreceptors, which are light-sensitive, responsible for acute vision and visual adaptation to changes in illumination [4,9]. Approximately 60% of the fatty acids present in retinal membrane phospholipids are DHA [4]. Despite such an important role for DHA in receptor structure, the results of clinical studies of the effects of supplementation of this compound on visual function are mixed. Jasani B and co-authors evaluated the safety and potential benefits of consuming modified milk enriched with long-chain fatty acids by infants born at term, with a particular focus on the effects on visual function. However, the study found no positive effects on visual acuity [10]. In contrast, Senapati et al. demonstrated that impairments in photoreceptor function and structure resulting from DHA deficiency can be reversed by adequate supplementation of this fatty acid in the diet [11].

Regulation of inflammation

DHA lowers plasma levels of pro-inflammatory markers such as C-reactive protein (CRP), interleukin-6 (IL-6) and tumour necrosis factor (TNF-α), which is particularly important in pregnancy to ensure proper immune balance [12]. It lowers the risk of pre-eclampsia and preterm labour, which can result from an inflammatory response [9,12]. Docosahexaenoic acid, through its metabolites such as resolvins and protectins, helps to control placental processes, thereby promoting normal fetal development [4,9].

Impact on the duration of pregnancy

DHA supplementation is associated with an increase in the length of pregnancy and a reduced risk of delivery before 37 weeks [13]. Docosahexaenoic acid affects the elasticity of the uterine membranes, reducing the risk of premature contractions and rupture of the fetal membranes [9]. According to one meta-analysis, DHA supplementation of 450-800 mg per day reduces the likelihood of preterm birth and may increase the weight of the newborn at birth [3]. Another study showed that plasma DHA concentrations were lower in patients who had preterm births, and these differences were observed as early as 16-20 weeks of gestation [1]. Docosahexaenoic acid supplementation has been shown to prolong the duration of pregnancy, reduce the risk of delivery before 37 weeks by 11% and before 34 weeks by up to 42% [14,15]. In addition, it contributes to increased neonatal birth weight and reduces the risk of perinatal infant death [14,15]. In conclusion, low plasma concentrations of DHA during pregnancy may indicate an increased risk of pre-term birth, while supplementation with this compound shows a preventive effect against this risk. Omega-3 fatty acids will reduce this risk through their anti-inflammatory properties by, among other things, reducing the amount of substances that cause preterm contractions and increasing the expression of the protein connexin 43, which is responsible for stabilising cell membranes [2].

Supporting the baby's birth weight

Women who consume adequate amounts of DHA during pregnancy are more likely to give birth to normal-weight babies [4,14]. This, in turn, contributes to a reduced risk of health complications in newborns [4,14]. In their paper, Jiang and co-authors summarised the results of studies that analysed the association between DHA intake and the occurrence of intrauterine growth retardation (IUGR) in the fetus [1]. This systematic review from June 2023 shows that levels of this compound in plasma and cord blood are reduced in patients with IUGR [1]. Docosahexaenoic acid supplementation during pregnancy may have a protective effect on foetal microcephaly and small head circumference [1,4,14]. Another study conducted by Gualtieri P. in Italy from November 2022 to July 2023. involved 501 pregnant women, in which it was determined how fish consumption and DHA supplementation correlates with the type of birth (natural, caesarean section) and the weight and length of the newborn [16]. The results were as follows: 74.3 per cent of women had a natural birth, the average birth weight was about 3.34

kg and the average length of the newborn was 50.42cm [16].
Low weight (<2500g) was reached by 3% of the babies born, and 7% of the babies weighed >4000g, 90% of the babies weighed between 2.5 and 4kg [16]. The study revealed a positive correlation between maternal fish consumption and higher birth weight [16].

Benefits for the mother

Current studies do not provide conclusive evidence that docosahexaenoic acid supplementation during pregnancy effectively prevents postnatal depression [8]. For example, a randomised controlled trial published in JAMA found that DHA consumption during pregnancy had no effect on reducing the risk of postnatal depression in mothers [8]. However, some sources suggest that DHA may support mental health through its anti-inflammatory properties and effects on brain function. An article on the Verywell Health website published in 2024 indicates that omega-3 fatty acids may improve mood and alleviate symptoms of depression by supporting production of neurotransmitters such as dopamine and serotonin [17]. In their work, Jiang and co-authors indicate that DHA supplementation may have important potential in the prevention and treatment of postpartum depression [1]. In addition to the benefits mentioned above, women taking DHA are less likely to develop gestational hypertension. This supplementation supports maternal cardiovascular health, contributing to lower triglyceride levels and improved vascular elasticity [4].

Other benefits for

DHA promotes the development of the immune system, which may help to reduce the risk of infections and inflammation in the first months of life [12]. Some studies indicate that DHA may also reduce the risk of allergies and asthma in children by modulating the immune response [4].

2. Sources of DHA and need during pregnancy:

The human body does not synthesise DHA in sufficient quantities, so it must be supplied from the diet or supplements. During pregnancy, the need for DHA increases as it is transported across the placenta to the foetus [9].

The largest sources of DHA are oily marine fish such as salmon, herring, trout and mackerel.
In addition, these fish are rich in iodine, selenium and other omega-3 fatty acids, including eicosopentaenoic acid (EPA), which supports the effects of DHA [4,16]. One of the challenges of eating fish is the risk of contamination with toxins such as mercury, dioxins or

polychlorinated biphenyls (PCBs) [16]. Pregnant women should avoid fish with high mercury content, such as shark, swordfish, bluefin tuna and king mackerel [16]. Safe options include salmon, herring, catfish, cod, sardines and Atlantic mackerel [16].

Other popular sources of DHA are fish oils and fish oils, as well as marine algae. Algae-based supplements are particularly recommended for vegans and vegetarians, as plant-based diets typically have insufficient amounts of DHA [17,18,19].

Although plants themselves do not contain docosahexaenoic acid, they are excellent for enriching the diet with alpha-linolenic acid (ALA), which has the ability to convert to DHA [18]. However, it is important to note that this process is quite limited - only 0.5-5% of ALA is converted to DHA [18,19]. Plant sources of alpha-linolenic acid include products such as flaxseed, chia seeds and rapeseed oil [18,19].

Due to the limitations associated with the natural intake of docosahexaenoic acid, supplementation is becoming a common and safe way to ensure adequate amounts of this compound in a pregnant woman's diet.

3. Risks and limitations of DHA supplementation during pregnancy

Although DHA supplementation during pregnancy is widely recommended due to its many health benefits, there are also some risks and limitations to consider. It is important to remember that most of the problems associated with supplementation are due to inadequate dosage, poor quality preparations or dietary errors.

Potential risks of DHA supplementation:

Marine fish, which are the main natural source of DHA, may be contaminated with heavy metals e.g. mercury, dioxins or polychlorinated biphenyls (PCBs), these in turn may be harmful to the developing foetus [16]. It is advisable to choose supplements labelled as purified from heavy metals and with quality certifications, e.g. USP (United States Pharmacopeia), IFOS (International Fish Oil Standards) [20].

DHA, like other omega-3 fatty acids, has anticoagulant effects, which can lead to an increased risk of bleeding. This is particularly relevant for women with blood clotting disorders or those taking anticoagulants such as heparin or aspirin [4]. High doses of DHA (more than 3 g per day) may increase this risk, especially in the third trimester of pregnancy or during labour [17]. Women with haematological problems should consult this supplementation with their doctor.

Excessive intake of DHA, especially in combination with other omega-3 supplements, vitamin

E or anti-inflammatory drugs, can lead to lipid imbalances in the body. As a result, undesirable symptoms such as headaches, blood pressure fluctuations or nausea may occur [4].

Some people may have an allergic reaction to DHA supplements, especially those made from fish [17]. Alternatively, preparations of plant origin (from marine algae) may be suitable also for vegetarians and vegans [17,18].

Limitations of DHA supplementation

Differences in bioavailability

The bioavailability of DHA varies depending on the source. Marine algae supplements may have lower bioavailability compared to fish-derived DHA [16]. In addition, the absorption of docosahesaenoic acid depends on the presence of other dietary components, such as fats, which aid its absorption [4].

Difficulty in identifying individual needs

DHA requirements during pregnancy vary according to diet, lifestyle and genetic conditions [21]. Established intakes (200-600 mg DHA per day) may be insufficient for women who consume very little omega-3 fats or struggle with omega-3 deficiency [17].

No immediate effect

The benefits of DHA supplementation, such as the development of cognitive function in the child, often become apparent only months or even years after birth [8]. Such a delay can lead to the misconception that supplementation has no effect.

Tolerance problems

Some women report gastrointestinal problems when taking DHA supplements, such as nausea, heartburn or abdominal pain [17]. This may be due to inadequate dosage or poor quality of the preparation.

Although DHA supplementation is generally safe and beneficial for the health of mother and baby, potential risks such as contaminants, drug interactions and tolerance problems must be considered. It is crucial to adhere to the recommended doses, to choose the right quality of supplements and to consult your doctor regularly to minimise possible adverse effects.

4. International recommendations on DHA supplementation during pregnancy

International health organisations in the fields of nutrition and medicine agree on the key role of DHA (docosahexaenoic acid) in foetal development and maternal health. Below, I provide detailed recommendations from the most important institutions.

1. World Health Organisation. The WHO recommends an intake of 300 mg per day of omega-3 fatty acids, including a minimum of 200 mg of DHA during pregnancy and lactation [22].
2. European Food Safety Authority. EFSA recommends DHA supplementation of 100-200 mg per day for pregnant women, in addition to the basic requirement for long-chain omega-3 fatty acids (250 mg EPA and DHA) [23].
3. National Institutes of Health. The NIH suggests a DHA intake of 300-500 mg per day for pregnant and breastfeeding women [24].
4. Canadian Paediatric Society. The CPS recommends an intake of at least 200-300 mg of DHA per day for pregnant and breastfeeding women [25].
5. Polish Society of Gynaecologists and Obstetricians. Polish guidelines suggest DHA supplementation of 200-600 mg daily, depending on the mother's diet. Women at risk of preterm birth should take up to 1000 mg of DHA daily [2].
6. The Food and Agriculture Organisation (FAO) recommends that pregnant and breastfeeding women consume a minimum of 250 mg of EPA and DHA per day, of which at least 200 mg should come from DHA [26].
7. The International Society for the Study of Fatty Acids and Lipids (ISSFAL) recommends that pregnant and breastfeeding women consume at least 200 mg of DHA daily [21].

Summary of key international recommendations:

- Minimum dose of DHA during pregnancy: 200 mg per day (EFSA, WHO).
- Recommended intake for optimal benefits: 300-600 mg per day (NIH, PTGiP).
- High risk of deficiencies or complications of pregnancy: up to 1000 mg per day (PTGiP, EFSA).

5. Future research directions for DHA supplementation in pregnancy

DHA supplementation during pregnancy has become an important topic in science and medicine, especially in the context of fetal development and maternal health. Although there is a lot of research confirming the benefits of providing adequate amounts of docosahexaenoic acid during this period, many questions still remain to be clarified. Future research can significantly contribute to a better understanding of the effects of DHA supplementation. Current recommendations for DHA doses in pregnancy are mainly based on clinical trials that have shown benefits in the range of 200-600 mg daily [9,17]. However, there are still no clear guidelines on what amount of DHA is most optimal. Long-term studies that analyse the effectiveness of DHA supplementation at different doses (from 200 mg to 1000 mg daily) are required. It is also important to compare the results with a control group to identify the most effective and safe doses.

Another important issue is the paucity of clear evidence on the long-term effects on cognitive development and mental health of the child later in life. Further research should focus on monitoring minors into pre-school, school age and adulthood to determine whether DHA supplementation during pregnancy has an impact on IQ, language skills, concentration, social behaviour, and the risk of disorders such as ADHD or autism spectrum disorders.

Another challenge is the need for comparative studies to assess the bioavailability of DHA from different sources. Such an analysis would help to better understand which formulations and sources of DHA are most effective, especially for women who have limited access to fish or follow a plant-based diet.

6. Discussion

The results of this review indicate that DHA supplementation during pregnancy may have important implications for maternal and child health. According to current knowledge, DHA plays a key role in the development of the fetal nervous system. A systematic review by Nevins et al. showed that the intake of omega-3 fatty acids during pregnancy and lactation can support the neurological development of the child [27]. In contrast, a study by Valentine et al. demonstrated a reduced risk of preterm birth [12]. In addition, some studies suggest that low levels of DHA in pregnant women are correlated with a higher risk of postnatal depression, indicating a potential benefit of its supplementation in the prevention of maternal mental health [29,30]. One of the key findings is also the effect of DHA on maternal and fetal immune function. It has been observed that increasing DHA intake can influence the immune response during pregnancy, with potentially positive effects on reducing inflammation and the risk of preterm birth [12, 28]. These observations confirm previous findings by the FAO and WHO, which highlight the broad anti-inflammatory effects of omega-3 fatty acids [31].

7. Summary and conclusions

DHA supplementation during pregnancy is widely recommended due to its numerous health benefits for both the mother and the developing baby. Results of studies to date indicate positive effects of DHA, especially on brain development, vision and fetal neurological function, as well as in the context of preventing some pregnancy complications. However, there are still insufficient data to precisely determine the optimal doses of this compound and the target maternal serum concentrations. Future studies on DHA supplementation, should focus on refining dosage, assessing long-term effects, determining interactions with diet and better understanding the effect of DHA on preventing pregnancy complications. These activities will help tailor recommendations and ensure the safety and effectiveness of DHA supplementation during this important period. In addition to DHA supplementation, it is important that the pregnant woman's diet is generally rich in healthy fats, proteins, vitamins and minerals.

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Conflict of Interest

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