Long-chain omega-3 fatty acid supply in pregnancy and lactation

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FROM ABSTRACT
Purpose of review:
Long-chain omega-3 fatty acids are essential for the developing fetus.

Docosahexaenoic acid, the most important omega-3 fatty acid, is an important component of neural and retinal membranes, and rapidly accumulates in the brain during gestation and the postnatal period.

Positive associations have been shown between maternal intake of fish, seafood and omega-3 fatty acids during pregnancy and/or lactation and visual and cognitive development.

Summary:
Omega-3 fatty acids have been associated with reduced risk of cardiovascular and other diseases.

Observational and interventional studies indicate a significant association with prolonging gestation and reducing the risk of preterm delivery both in low-risk and in high-risk pregnancies.

Further benefits have been suggested for intrauterine growth restriction, preeclampsia and postpartum depression.

Higher maternal docosahexaenoic acid intake both in pregnancy and lactation is associated with positive infant neurodevelopmental outcomes.

Women of reproductive age should achieve an average dietary docosahexaenoic acid intake of at least 200 mg/day.

THESE AUTHORS ALSO NOTE:

“The dietary essential omega-3 fatty acid (FA), alpha-linolenic (ALA; 18: 3n-3) is the precursor of long-chain polyunsaturated derivatives (LCPUFA), eicosapentaenoic (EPA; 20: 5n-3) and docosahexaenoic acid (DHA; 22: 6n-3), which are important structural elements of cell membranes that are needed for the normal development of the central nervous system and retina.”

The biological roles of omega-3 FAs include:

1) Eicosanoid metabolism
2) Membrane properties
3) Regulation of gene expression

DHA is the most important of these omega-3 molecules, being incorporated into the membrane phospholipids of brain and retina.

Omega-3 FA intake is particularly important in pregnancy.

Omega-3 FAs accumulate in fetal tissue at a particularly high rate.

The conversion of the essential plant based omega-3 FA ALA to EPA and DHA is low, and therefore consumption of preformed DHA and EPA is required.

The major sources of EPA and DHA omega-3s are "fish and seafood."

The major sources of omega-6s are, "seed oils, eggs, poultry and pig meat."

The average dietary supply of omega-3s in pregnancy is low both in Europe and in North America.

Higher concentrations of omega-3s modify the balance of production of prostaglandins involved in the initiation of labor, allowing for a longer gestation and reducing the risk of early preterm delivery.

EPA and DHA omega-3 intake during pregnancy is associated with greater growth measures at birth.

There are concerns about the health risks from the environmental contaminants found in fish.

"In recent years, omega-3 EPA and DHA have been specifically recommended for the secondary prevention of cardiovascular disease, and they have been the focus of considerable attention for the prevention and treatment of disorders with an inflammatory component, including mental disorders."

Greater dietary intakes of n-6 FA increase tissue concentrations of arachidonic acid, while reducing tissue concentrations of omega-3s EPA and DHA.

Lower DHA together with a higher n-6 to n-3 ratio was reported in women who developed postpartum depression.

Dietary intakes of omega-3s are inversely related to postpartum depression.

"In countries with low omega-3 intake, the prevalence of postpartum depression is 50-fold higher than that in those with the highest intake."

Omega-3 intakes of up to 2.8 g/day show a significant reduction in depression during pregnancy and the postpartum period.

DHA is the main component of mature brain.

The placental supply of EPA and DHA are critical for the synthesis of structural lipids, and, hence, to normal fetal development.

“Preformed dietary DHA has been shown to be significantly more efficient as a DHA source for the neonatal brain than ALA [plant-based omega-3, as in flax oil].”

“Oral supplementation of long-chain omega-3 FAs both from fish oil and from single cell organisms to women of childbearing age is effective in increasing DHA contents of blood lipids.”

Supplementation with DHA oil to pregnant women increases the fetal supply.

Reduced maternal omega-3 accumulation during the first half of pregnancy restrains intrauterine development and may have long-term consequences on glucose tolerance later in life.

“DHA is enriched in brain grey matter and retina phospholipids, but its content decreases with low-dietary supply, leading to impaired neurogenesis, altered gene expression and neurotransmitters and decreased kinetics of the visual photocycle.”

DHA deficiency during pregnancy causes disturbances in offspring brain development.

Autopsies from infants who had received breast milk, known to contain DHA, showed significantly higher concentrations of DHA in the cerebral cortex than did infants fed with formulas without DHA.

Increased maternal intake of fish and seafood during pregnancy and/or lactation improve fetal visual and cognitive development, as well as other functional outcomes.

“Strong beneficial effects on development of verbal intelligence quotient, fine motor function and social behavior were observed in the children up to 8 years of age with higher maternal seafood intakes during the last period of pregnancy.”

“A dose–response relationship was found between the amount of seafood consumed and later verbal intelligence quotient development, with close-to-optimal outcomes at a fish intake providing approximately 200 mg DHA per day. The authors concluded that the risks from loss of biologically important nutrients by avoiding fish consumption were higher than the risks of harm from exposure to trace contaminants.”

A review of studies note that increased brain levels of DHA is associated with:

1) Improved cognitive or behavioral performance
2) Improved infant problem-solving

Studies suggest that the maternal diet should be balanced in omega-6 and omega-3 status.

DHA supplementation during pregnancy modulates the immune phenotype and decreases inflammatory cytokines, suggesting a role for allergy prevention.

"Many studies during pregnancy and lactation have shown that omega-3 FAs have a significant influence on pregnancy outcomes, nervous system function and development of the child."

"Pregnant and lactating women should aim to achieve an average DHA intake of at least 200 mg/day to reduce the risk of early preterm birth and to ensure adequate DHA deposition in brain and other tissues during critical developmental periods. This recommended intake of DHA can be reached by consuming one to two portions of sea fish per week, including oily fish as a good source of omega-3s."

Intakes of 1 g/day DHA or 2.7 g/day of EPA plus DHA omega-3 have been used in clinical trials with no significant adverse effects.

For infants, at least 1 g of DHA is needed to raise breast milk DHA to optimal levels, and this "amount [1 g of DHA per day] is much higher than the average dietary intake in most of the western countries."

CONCLUSIONS

"The dietary intake of omega-3 FAs, and, in particular, of DHA, during pregnancy and lactation has biologically important effects on gestation length and the risk of preterm delivery, and may have an effect on other pregnancy outcomes such as fetal growth, preeclampsia and postpartum depression."

"DHA supply to the fetus and the neonate is associated with beneficial effects on later cognitive development and visual function."

"Dietary advice should be given to women of childbearing age in order to achieve a regular intake of adequate amounts of DHA in their diets."

KEY POINTS FROM DAN MURPHY

1) The long-chain omega-3 fatty acids EPA and DHA are essential for the developing fetus.

2) Docosahexaenoic acid (DHA) is the most important omega-3 fatty acid. It is an important component of neural and retinal membranes, and rapidly accumulates in the brain during gestation and the postnatal period.

3) Increased maternal intake of fish, seafood and omega-3 fatty acids during pregnancy and/or lactation improves infant visual and cognitive development, and other neurological developments.

4) Omega-3 fatty acids have been associated with reduced risk of cardiovascular and other diseases.

5) Plant derived essential omega-3 fatty acid alpha-linolenic (ALA) is poorly converted into the long-chain omega-3s eicosapentaenoic (EPA) and docosahexaenoic acid (DHA); yet, it is the long-chain EPA and DHA "which are important structural elements of cell membranes that are needed for the normal development of the central nervous system and retina."

6) The conversion of the essential plant based omega-3 FA ALA to EPA and DHA is low, and therefore consumption of preformed DHA and EPA is required.

7) The major sources of EPA and DHA omega-3s are "fish and seafood."

8) Omega-3 FA intake is particularly important in pregnancy.

9) Omega-3 FAs accumulate in fetal tissue at a particularly high rate.

10) The major sources of omega-6s are, "seed oils, eggs, poultry and pig meat."

11) The average dietary supply of omega-3s in pregnancy is low both in Europe and in North America.

12) Higher concentrations of omega-3s modify the balance of production of prostaglandins involved in the initiation of labor, allowing for a longer gestation and reducing the risk of early preterm delivery.

13) There are concerns about the health risks from the environmental contaminants found in fish.
[Consequently, clinicians usually recommend consumption of fish oil supplements from which the contaminants have been removed].

14) “Omega-3 EPA and DHA have been specifically recommended for the secondary prevention of cardiovascular disease, and they have been the focus of considerable attention for the prevention and treatment of disorders with an inflammatory component, including mental disorders.”

15) Lower DHA together with a higher n-6 to n-3 ratio is reported in women who developed postpartum depression.

16) “In countries with low omega-3 intake, the prevalence of postpartum depression is 50-fold higher than that in those with the highest intake.”

17) Omega-3 intakes of up to 2.8 g/day show a significant reduction in depression during pregnancy and the postpartum period.

18) “Oral supplementation of long-chain omega-3 FAs both from fish oil and from single cell organisms to women of childbearing age is effective in increasing DHA contents of blood lipids.”

19) Supplementation with DHA oil to pregnant women increases the fetal supply.

20) Reduced maternal omega-3 accumulation during the first half of pregnancy restrains intrauterine development and may have long-term consequences on glucose tolerance later in life [diabetes risk].

21) DHA deficiency during pregnancy causes disturbances in offspring brain development.

22) Autopsies from infants who had received breast milk, known to contain DHA, showed significantly higher concentrations of DHA in the cerebral cortex than did infants fed with formulas without DHA.

23) Increased maternal intake of fish and seafood during pregnancy and/or lactation improve fetal visual and cognitive development, as well as other functional outcomes.

24) “Strong beneficial effects on development of verbal intelligence quotient, fine motor function and social behavior were observed in the children up to 8 years of age with higher maternal seafood intakes during the last period of pregnancy.”

25) “A dose–response relationship was found between the amount of seafood consumed and later verbal intelligence quotient development, with close-to-optimal outcomes at a fish intake providing approximately 200 mg DHA per day. The authors concluded that the risks from loss of biologically important nutrients by avoiding fish consumption were higher than the risks of harm from exposure to trace contaminants.”

26) A review of studies note that increased brain levels of DHA is associated with:

A)) Improved cognitive or behavioral performance

B)) Improved infant problem-solving

27) Studies suggest that the maternal diet should be balanced in omega-6 and omega-3 status.

28) DHA supplementation during pregnancy improves infant allergy prevention.

29) "Many studies during pregnancy and lactation have shown that omega-3 FAs have a significant influence on pregnancy outcomes, nervous system function and development of the child."

30) "Pregnant and lactating women should aim to achieve an average DHA intake of at least 200 mg/day to reduce the risk of early preterm birth and to ensure adequate DHA deposition in brain and other tissues during critical developmental periods. This recommended intake of DHA can be reached by consuming one to two portions of sea fish per week, including oily fish as a good source of omega-3s."

31) For infants, at least 1 g of DHA is needed to raise breast milk DHA to optimal levels, and this "amount [1 g of DHA per day] is much higher than the average dietary intake in most of the western countries."

32) "The dietary intake of omega-3 FAs, and, in particular, of DHA, during pregnancy and lactation has biologically important effects on gestation length and the risk of preterm delivery, and may have an effect on other pregnancy outcomes such as fetal growth, preeclampsia and postpartum depression."

33) "DHA supply to the fetus and the neonate is associated with beneficial effects on later cognitive development and visual function."

34) "Dietary advice should be given to women of childbearing age in order to achieve a regular intake of adequate amounts of DHA in their diets."