



# Consumption of omega-3 fatty acids and women's health

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## Abstract

### Introduction

There is a substantial amount of evidence to support the role of long chain omega-3 fatty acids in the maintenance of optimal health and in the prevention of chronic disease. While many chronic conditions are not gender specific, there are emerging studies based on cohorts of women, specifically relevant to women's health. Additionally, maternal and infant consumption of long chain omega-3 fatty acids as a part of a healthy and balanced diet can have lifelong effects on health outcomes. This review is a comprehensive look at research into the health benefits of long chain omega-3 fatty acids on women's health. Research on female cohorts and that relating to issues specific to women's health are reviewed.

### Conclusion

Research shows clear benefits to women's health from consumption of the marine sourced long chain omega-3 fatty acids. Evidence pertains to reductions in all-cause morbidity, coronary heart and cardiovascular disease, mental health including depression, dementia and Alzheimer's disease, polycystic ovarian syndrome, dysmenorrhoea and infant cognitive development.

### Introduction

Early epidemiological studies suggested a relationship between plasma lipid and lipoprotein profiles in Greenland Eskimos and a low

incidence of ischaemic heart disease and an absence of diabetes mellitus<sup>1</sup>. These early observations inspired researchers of other indigenous populations to question the role of long-chain omega-3 polyunsaturated fatty acids (n-3 LC-PUFA) in the prevention of cardiovascular disease mortality<sup>2</sup>. Since this time, research has revealed evidence health benefits of consumption of n-3 LC-PUFA in all-cause mortality, cardiovascular health, coronary heart disease, inflammatory disorders including asthma and allergy, neurodegenerative diseases, mental health including dementia and Alzheimer's disease, behavioural disorders, diabetes, maternal health, immune responses, age related factors and some cancers<sup>3-7</sup>. Experts have identified that increased plasma levels of n-3 LC-PUFA, on a population level, has the potential to reduce incidence of major chronic diseases responsible for the global burden of disease<sup>8</sup>.

While many of the benefits associated with consumption of n-3 LC-PUFA and/or seafood have a whole of population significance, there remain many areas of health advancements of particular relevance to women's health. Additionally, there is scientific evidence from studies of chronic conditions such as cardiovascular disease carried out with cohorts of women. This paper will explore those benefits of n-3 LC-PUFA consumption specific to women's health and significant research relating to cohorts of women.

### Background

The most common n-3 LC-PUFAs found in the human diet are  $\alpha$ -linoleic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid

(DHA). ALA is classed as an essential fatty acid as it is essential for optimal health; humans are unable to synthesise ALA and as such it must be consumed in the diet. ALA is found in canola and other seed crops. EPA and DHA are marine sourced fatty acids found in fish and seafood. Humans are able to convert ALA to EPA and DHA and while researchers continue to debate conversion rates, it is clear that conversion is limited<sup>9</sup>.

The physiological efficacy of ALA, EPA and DHA is not equal. The strongest evidence of health benefits associated with the consumption of n-3 LC-PUFAs has been demonstrated with the marine sourced n-3 LC-PUFAs and with dietary patterns that feature seafood consumption<sup>9</sup>. The efficacy of n-3 LC-PUFAs in both primary and secondary prevention of cardiovascular disease, for example, has been reviewed and identified as being dependent on the n-3 LC-PUFA studied; consumption of n-3 LC-PUFAs from fish or fish oil, and not ALA, was found to improve rates of all-cause mortality, cardiac and sudden death and potentially also stroke<sup>10</sup>.

With the purpose of reviewing the benefits of n-3 LC-PUFA consumption to women's health, research has been reviewed from investigations with foci on of one or more n-3 LC-PUFA as well as those that examine intake of fish and seafood.

### Pregnancy and lactation

Women's health during pregnancy and lactation has long-term implications for both the mother and child. A healthy and balanced diet is critical as women have greater nutritional requirements during pregnancy and lactation<sup>11</sup>.

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Maternal nutrition is well established as being important to foetal brain development<sup>12</sup> and there is mounting evidence for n-3 PUFA intakes in particular having benefits for a number of infant birth outcomes<sup>13</sup>. High levels of fish consumption during pregnancy have been associated with longer gestation<sup>14</sup>, increased birth weight and lower rates of maternal hypertension during pregnancy<sup>15-17</sup>.

In addition to positive pregnancy outcomes and in utero neurodevelopment<sup>16,18</sup>, consumption of n-3 LC-PUFA during pregnancy also promotes optimum neurodevelopment of infants after birth<sup>19</sup>. Observations from research conducted with premature infants have shown that the total amount of PUFA in a mother's breast milk to be positively associated with weight gain, height and body mass index<sup>20</sup>. Further, consumption of two salmon meals per week during pregnancy has shown to lower inflammatory markers in offspring which is associated with a decreased risk of cardiovascular disease<sup>18</sup>.

There is evidence that the benefits associated with maternal nutrition and n-3 LC-PUFA status has long lasting effects. Greater maternal fish consumption has been linked to higher child developmental scores at 18 months, specifically improved performance on language and visual motor skills<sup>16,17</sup> and visual development<sup>21</sup>. Benefits of n-3 LC-PUFA and child health are further demonstrated through associations between prenatal availability of long chain PUFA and the motor function of children at 7 years of age<sup>22</sup>.

Cross-national studies support recommendations that women of childbearing age should ingest at least 200 mg of DHA per day for optimal health benefit<sup>23,24</sup>. Consumption of one to two serves of oily fish per week will provide the 200 mg of DHA or more recommended each week. During pregnancy, at least 340 grams of seafood should be ingested weekly for beneficial effects on child

development<sup>25</sup>. The ideal dose of n-3 LC-PUFA, composition and ratio of EPA:DHA to maximise child development requires further investigation<sup>26</sup>.

### Mental health

Depression is consistently responsible for the greatest burden of disease in women across low-, middle- and high-income countries<sup>27</sup>. Frequent fish and omega-3 PUFA consumption has been associated with a decreased risk of depression and depressive symptoms<sup>28</sup>. Cross-sectional data support the protective effect of high intakes of fish and omega-3s on the risk of psychotic like symptoms<sup>29</sup>. Significantly, lower intakes of fish and seafood have been observed in female suicide attempters than non-attempters<sup>30</sup>.

It is estimated that post-partum depression affects between 10 and 15% of mothers<sup>31</sup>. Further, experts calculate that the global disease burden of postpartum depression potentially attributable to low levels of n-3 LC-PUFA is 65.5%<sup>8</sup>. Women have greater nutritional requirements during pregnancy and lactation and as such may be at greater risk of nutrient deficiencies, increasing their risk of depression<sup>11</sup>. Adequate DHA concentration in breast milk has a strong negative correlation with postpartum depression rates<sup>32</sup>. A small cohort showed that pregnant women with lower levels of n-3 LC-PUFA were six times more likely to have antenatal depression than women with higher levels<sup>33</sup>. Although further research is required, EPA and DHA supplementation may be beneficial for women with perinatal depression<sup>34</sup>.

### Cardiovascular and coronary heart disease

There is substantial robust evidence about the benefits of n-3 LC-PUFA and/or seafood consumption for heart health<sup>6</sup>. While heart health is not necessarily gender specific, there is additional evidence of health benefits in studies carried out on female

cohorts. Consumption of fish as part of a healthy diet has been concluded to assist in the prevention of coronary heart disease in women<sup>35</sup>.

A study of 84,688 female nurses were reviewed for 16 years; results clearly showed that higher fish and n-3 LC-PUFA consumption rates were related to a lower risk of coronary heart disease and in particular death from coronary heart disease<sup>36</sup>. The authors recommend fish consumption twice weekly for prevention of coronary heart disease. A similar cohort of 79,839 women followed for 14 years found a significant inverse relationship between fish intake and risk of thrombotic stroke<sup>37</sup>. The researchers reviewed mechanisms by which fish intake could reduce stroke and offered many suggestions: inhibition of platelet aggregation, lower blood viscosity, reduced formation of leukotrienes, lower plasma fibrinogen, as well as lower blood pressure and insulin resistance.

### Cancer

Animal studies have found that a high-fat diet with a high content of n-3 LC-PUFA could suppress the growth of breast cancer cells in mice<sup>38</sup>. The author concludes that there is a need for dietary intervention trials to be carried out on post-surgical breast cancer patients. In support of these findings, it has been revealed that post-menopausal women who consume fish have a significantly reduced risk of breast cancer when compared with red meat consumers<sup>39</sup>.

### Healthy aging

Older women with higher n-3 LC-PUFA and fish intakes have a 43% reduction in risk of mortality from non-cardiovascular, non-cancer inflammatory diseases<sup>40</sup>. High intakes of sea fish are independently associated with greater bone mass and lower osteoporosis risk in women, especially those consuming more than 250 grams of seafood per week<sup>41</sup>.



There is sufficient commonality in research outcomes to suggest that a healthy diet, rich in n-3 LC-PUFA combined with healthful lifestyle factors such as exercise, low alcohol consumption and smoking avoidance, has the potential to delay the onset of and reduce the risk of dementia and Alzheimer's disease<sup>7</sup>.

### Other benefits to women's health

Daily n-3 LC-PUFA supplementation has shown to significantly reduce the symptoms and pain of dysmenorrhea<sup>42,43</sup>.

Polycystic ovarian syndrome (PCOS) is the most common endocrine disorder affecting women of reproductive age. There is an association between PCOS and both non-alcohol liver disease and risk factors of cardiovascular disease. Supplementation of omega-3 PUFA in women with PCOS has shown to have beneficial effects on both non-alcoholic fatty liver disease and traditional cardiovascular risk factors<sup>44</sup>.

### Discussion

The authors have referenced some of their own studies in this review. These referenced studies have been conducted in accordance with the Declaration of Helsinki (1964) and the protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed. All human subjects, in these referenced studies, gave informed consent to participate in these studies.

The health benefits of n-3 LC-PUFA consumption have been extensively researched and are well established for many chronic conditions. While many of these are not gender specific, the significant health benefits with regard to cardiovascular health, mental health, inflammatory conditions such as rheumatoid arthritis, child cognitive development, some cancers and all-cause mortality are clear. Despite the overwhelming evidence, however, studies carried

out on women of childbearing age reveal that not enough are consuming adequate fish for health benefits<sup>45</sup>. Additionally, it appears that some pregnant women have limited knowledge of the benefits of n-3 LC-PUFA intake during pregnancy<sup>46</sup> and that this can be confounded by concerns of contamination of fish.

Fish and seafood are potential sources of exposure to pollutants such as methylmercury that may adversely affect pregnancy outcomes. Thus, advising pregnant women about fish consumption requires consideration of potential risks as well as benefits<sup>15,47</sup>. Methylmercury is bioaccumulative in the marine food chain and concentration is dependent on the size, age and species of the fish as well as the water from which it is harvested. Concentrations are highest in those species at the top of the food chain such as shark and swordfish and large species that feed on fish; lowest levels of methylmercury are found in smaller herbivorous fish. Fish and seafood intake guidelines for women, who are pregnant, may become pregnant or are breastfeeding need to be specific about consumption of fish species to ensure adequate intakes of n-3 LC-PUFA and minimal intake of methylmercury<sup>48</sup>. The beneficial effects on child development of maternal seafood intake of more than 340 grams per week are such that advice to limit seafood consumption could actually be detrimental; risks from the loss of nutrients is greater than the risks of harm from exposure to trace contaminants in 340 grams seafood eaten weekly<sup>25</sup>.

Promoting the consumption of n-3 LC-PUFA for optimal health throughout life appears obvious in the face of the evidence. Unfortunately, the message is in fact complex. The majority of evidence of benefits to health stems from the marine sourced n-3 LC-PUFA, DHA and EPA, and not ALA<sup>9</sup>. Additionally, n-3 LC-PUFA consumption needs to be considered against

the background diet. The low ratio of omega-6 to omega-3 fatty acids is needed for the prevention of chronic disease<sup>49</sup>. Anthropological data suggest humans evolved from a diet where this ratio was approximately 1:1 whereas a modern Western diet has a ratio ranging from 15:1 to 16.7:1<sup>49</sup>. The ratio is important because omega-6 fatty acids have an antagonistic physiological role to n-3 LC-PUFA, specifically they promote the pathogenesis of many chronic diseases such as cardiovascular disease, osteoporosis, cancer, autoimmune and inflammatory disorders<sup>49</sup>.

Research into positive health outcomes and nutrition is revealing the strongest evidence with relation to dietary patterns rather than to individual nutrients; a whole diet approach is further supported by the complexity of multiple macro- and micro-nutrient requirements and interactions<sup>50</sup>. Despite the multifaceted science of n-3 LC-PUFA, it is clear from a vast body of research outcomes that marine sourced n-3 LC-PUFA offer benefits to health. While no nutrient works in isolation<sup>51</sup>, and fish and seafood offer many valuable nutrients beyond their n-3 LC-PUFA content, supplements and fortified foods offer a valuable dietary resource for those who do not eat seafood.

### Conclusion

Health benefits associated with consumption of n-3 LC-PUFA are well established both with regard to specific conditions and all-cause mortality. Gender differences in physiology and metabolism have spurred research and discourse into the benefits of n-3 LC-PUFA specific to male and female health as well as to those conditions that are gender specific by nature.

Consumption of marine sourced n-3 LC PUFA as a part of healthy balanced diet has many benefits for women's health including prevention of cardiovascular disease, coronary heart disease, inflammatory disorders, mental health, maternal and



child health, infant cognitive development and some cancers.

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