

Omega-3 essential fatty acids: the benefits

Dr Carrie Ruxton

The following e-feature bulletin from The Health Supplements Information Service takes a look at fish oils and omega-3 fatty acids; investigating what they are, how we obtain them from the diet, and what exactly they do in our bodies from infancy through to our golden years.

What are omega-3 fatty acids?

Omega-3 polyunsaturated fatty acids (PUFA) are a group of fatty acids vital for normal development and long-term health. Omega-3s are required across the whole lifecycle, beginning in the womb and continuing through to old age. They are essential for all the cells in the body, particularly those in the brain, retina, nervous system, immune system, and circulation. There are different types omega-3 fatty acids, each with a specific chemical structure, but the key health benefits are thought to come from the very long chain omega-3s, called docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA).

How do we obtain omega-3 fatty acids?

DHA and EPA can be synthesised in our bodies from the essential fatty acid, alpha-linolenic acid (ALA), but the process is very slow and inefficient, and can be inhibited by too many omega-6 fatty acids in the diet (e.g. from vegetable oils). This is why most experts advise that DHA and EPA are consumed directly from rich dietary sources such as salmon, trout, mackerel, sardines, fresh tuna and pilchards, i.e. oil-rich fish.

Research shows that two out of three people in the UK - the majority of adults - do not eat the two portions of fish a week recommended by the Food Standards Agency^{1 2}, either because it doesn't fit in with their lifestyle or simply because they don't like fish, especially oily fish. The statistics for young people are even worse. Amongst those aged 19 to 24 years old, only 13 per cent of women and 3 per cent of men eat oily fish.³ Only 3 per cent of children and 15 per cent of adults from a low income background report eating oily fish.⁴

As a result, a huge percentage of the population is missing out on vital omega-3s for health. Fish oil supplements can provide a valuable way of bridging the nutritional gap for those people; whose diets may be lacking in the essential nutrients provided by fish, including those whose intakes are erratic.

What is the significance of DHA and EPA?

The two key omega-3 fatty acids – DHA and EPA – play somewhat different but complementary roles. In the brain, for example, DHA has a structural role, while EPA has a functional role. These differences are of relevance to health throughout life. As a structural fatty acid, DHA is important for healthy development through infancy and very early childhood. DHA is thought to be crucial in the development of neural pathways in the brain, and normal development of the retina and immune system. This is why certain products aimed at pregnant women and babies are generally formulated with a high DHA content.

EPA, on the other hand, as part of its functional role, is thought to support normal communication between cells in the brain, making it crucial from early childhood and throughout life. This means that the ideal balance of omega-3s includes both EPA and DHA and, if a supplement is to be taken, this should be formulated with a relatively high

EPA content. It is important to note that omega-3 food supplement formulations are generally designed to optimise the incorporation and function of both fatty acids.

Docosahexaenoic Acid (DHA): Structural fatty acid

During the development of the brain, throughout pregnancy and during the early years of life, structural fatty acids like DHA are particularly important. DHA is an essential part of the building blocks of the brain, nervous system and eyes. In fact, DHA makes up approximately 97% of all omega-3 fatty acids found in the brain, and 93% of omega-3s found in the eyes.^{5 6}

The typical growth-spurt seen in the brains of foetuses in late pregnancy and the first year of life can often lead to fatty acid deficiencies in mothers and their babies. Supplementing pregnant and breast-feeding women, and/or their babies, with DHA has been found to benefit infant eye development, sleeping patterns, allergies and subsequent mental abilities⁷ with improvements in child IQ seen after four years, according to one study.⁸

Eicosapentaenoic Acid (EPA): Functional fatty acid

Emerging research suggests that the functional omega-3, EPA, is extremely important once the brain has stopped growing, as it helps in the transmission of messages between cells. After two years of age, the brain and eyes have fully developed and there is then a need to ensure that all of the cells are functioning and communicating effectively.

The high EPA omega-3 formulation used in certain robust clinical studies has been found to benefit cognitive function, e.g. reading, writing and spelling, in children in mainstream education who had learning difficulties (such as developmental coordination disorder (DCD) and attention deficit hyperactivity disorder (ADHD)).⁹

Certain omega-3 supplements aimed at pregnant women and babies are generally formulated with a high DHA content, while those formulated for childhood and adulthood have a relatively higher level of EPA. It is, however, important to note that all omega-3 formulations are designed to maximise the incorporation and function of both fatty acids.

Overall benefits of omega-3 fatty acids

Omega-3 fatty acids are essential to health and are associated with many health benefits as confirmed by a recent review of the scientific evidence.¹⁰ In summary these benefits include:

Heart health

Omega-3 fatty acids are well known for their heart health benefits with a significant body of evidence pointing towards improved vascular and heart health. Large-scale studies have suggested that higher intakes of omega-3s and fish are linked with a lower risk of heart disease and death from heart attacks. Some studies also link high intakes of omega-3s with a reduced risk of stroke. One study found that hospital admissions for cardiovascular (CV) disease were lowest in those people regularly taking omega-3 supplements.¹¹

Evidence suggests that omega-3s can:

- Reduce blood viscosity and inflammation in CV disease patients
- Improve arterial elasticity, with benefit for blood pressure control
- Reduce the risk of dangerous irregular heart rhythms (arrhythmias)
- Reduce levels of triglycerides - blood fats linked with heart disease
- Reduce the risk of potentially harmful blood clots
- Slow the growth rate of arterial plaques

Immune function

Research also suggests that omega-3s are associated with a lower risk of conditions where immune abnormalities play a role. Omega-3s may help symptoms of rheumatoid arthritis¹², asthma, eczema,¹³ psoriasis and inflammatory bowel disease, all conditions which are associated with an exaggerated inflammatory response and unbalanced immune function. Omega-3s are known to inhibit inflammatory chemicals by favouring pathways that make non-inflammatory chemicals.¹⁴

Mental and cognitive health

Omega-3s are associated with normal cognitive development in infancy and childhood, and also normal mental health in adulthood. Several trials have evaluated the potential role for omega-3s in mental and cognitive health in children with pre-existing learning conditions.

Low fish intake is linked with an increased risk of depression. Supplementation has been shown in some studies to reduce symptoms of depression¹⁵ with deficiencies raising the risk of suicide or personality disorders.¹⁶ People with higher fish intakes or higher levels of DHA in the blood are also more likely to maintain cognitive function as they age. Fish and omega-3 consumption have been linked with a lower risk of dementia.¹⁷

Schoolchildren

UK diet data show that for 4 to 18 year olds, average intake of oily fish was less than 0.1 portions a week, ten times less than the recommended one portion a week.¹⁸ This means omega-3 intakes are likely to be insufficient for this age group. There is evidence that essential fatty acids play a key role in supporting cognitive function and mood in children.¹⁹ ²⁰ Current guidelines for omega-3 PUFA intake relate only to adults, but researchers say recommended intakes for children should also be defined in the UK.²¹

In addition, a better omega-3 status (estimated by fatty acid levels in the blood) has been associated with improved markers of cardiovascular health in adolescent boys.²² UK trials on the effect of fatty acids supplements taken for three months have demonstrated improvements in reading, spelling and overall behaviour in both healthy children, and in those with developmental coordination disorders such as attention deficit hyperactive disorder.^{23 24} One three-month study found pupils had improved reading, spelling and behaviour following supplementation.²⁵ A trial involving autistic children had similar results.²⁶ Overall, the existing body of work surrounding fatty acids, classroom achievement and behaviour would seem to support a role for essential fatty acid supplementation for children with learning difficulties.

Pregnant women

A good omega-3 PUFA intake has been shown to be hugely important for pregnant women, both for their health and that of their unborn child. Omega-3s are known to be essential for normal foetal development. Despite this, dietary data indicate that women of childbearing age in the UK have omega-3 intakes of only 98 to 203 mg per day,²⁷ less than half the recommended 450mg a day.

For pregnant women, there is evidence that omega-3 PUFA may:

- Increase pregnancy duration and infant head circumference, with both elements beneficial to a baby's health.²⁸
- Support a child's normal brain and eye development and improve IQ, motor skills, communication and hand / eye co-ordination.^{29 30 31}
- Help prevent maternal depression, both during and after pregnancy.^{32 33}
- Lower the risk of babies developing asthma, eczema or allergies.³⁴
- Improve omega-3 levels in mothers' breast milk, along with beneficial antibodies known to support infant immune development.^{35 36}

- Improve children's mental processing well into childhood.³⁷

Older people and ageing

Interestingly, higher blood levels of omega-3 fatty acids have been associated with a beneficial change in a biological marker – called the telomere – which is a part of the chromosome and which reflects cell ageing (a bit like a body clock). Ageing is associated with reduced telomere length and this study showed that the telomeres of people with *higher* blood levels of omega-3s were shortening much more slowly than people who had low blood levels of omega-3s.

There is evidence that omega-3 PUFA help maintain cognitive function during ageing.³⁸ Both DHA and EPA may have beneficial effects on neural function, inflammation, oxidation and cell death, which can contribute to lowering the risk of Alzheimer's disease. Studies show that cognitive function in later life declines faster, and the risk of dementia increases, when intakes of long-chain omega-3 PUFA are low.³⁹ One study found that a high omega-3 intake was associated with a significantly lowered risk of developing Alzheimer's.⁴⁰ In other research, omega-3 PUFA was linked with a 60% reduction in dementia, along with a reduction in cognitive decline.⁴¹

While older people tend to eat more fish and oily fish than other age groups, diet data show that 50 to 64 year olds have an omega-3 intake of about 330mg a day⁴², which is significantly below than the recommended 450mg. Those most at risk of deficiency include people in their 80s and those in institutions, leading to calls for older people to take supplements.⁴³

Cancer

Research in other areas suggests that omega-3 fatty acids may provide benefits beyond reducing the risk of cardiovascular disease. Observational evidence links oily fish intake with a reduced risk of bowel and breast cancer, possibly through an inhibition of chemicals that stimulate cancer growth, or through a re-balancing of hormones such as oestrogen.⁴⁴

Are we getting enough?

The UK Department of Health recommends eating two portions of fish a week, at least one of which should be oily fish (e.g. sardines, mackerel or salmon). This equates to a daily intake of 450 mg of omega-3 PUFA, principally as EPA and DHA.⁴⁵

Only 27 per cent of adults eat oily fish at all, with an average intake of omega-3 fatty acids of 270mg, half of which comes from oily fish. For the other 73 per cent of the population who do not consume oily fish, the mean intake of omega-3 fatty acids is only 147mg daily, falling well below recommended levels.⁴⁶

Omega-3 supplementation

Supplementation is considered a safe and effective way of boosting omega-3 fatty acid intakes, with research suggesting that supplements can be as useful as eating oily fish. Given that fish is not consumed universally, particularly by children, during pregnancy, and young people who need it the most, supplements have a major role to play in boosting omega-3 intakes. Studies have shown that fish oil and omega-3 supplementation can be just as effective as eating oily fish in raising omega-3 levels.⁴⁷

FOR FURTHER INFORMATION CONTACT:

EMMA SANDERSON on 0207 052 8853 or email: emma.sanderson@nexuspr
NICKY SMITH on 020 7052 8850 or email: nicky.smith@nexuspr.com

References for omega-3 benefits

- ¹ National Diet and Nutrition Survey, adults aged 19 to 64 years., Vol 1. Types and quantities of foods consumed, 2002.
- ² Low income diet and nutrition survey. Vol 2. Food consumption. Nutrition intake. A survey carried out on behalf of the Food Standards Agency. London: The Stationery Office 2007.
- ³ National Diet and Nutrition Survey, adults aged 19 to 64 years, Vol 3, Vitamin and mineral intake and urinary analysis. HMSO London 2003.
- ⁴ Low income diet and nutrition survey. Vol 2. Food consumption. Nutrition intake. A survey carried out on behalf of the Food Standards Agency. London: The Stationery Office 2007.
- ⁵ Lauritzen L, et al. The essentiality of long chain n-3 fatty acids in relation to development and [function](#) of the brain and retina. *Prog Lipid Res*, 2001. 40:1-94.
- ⁶ Martinez M. Tissue levels of polyunsaturated fatty acids during early human development. *Pediatr*, 1992.120:S129-38
- ⁷ Cohen JT, et al. A quantitative analysis of prenatal intake of n-3 polyunsaturated fatty acids and cognitive development. *Am J Prev Med*, 2005. 29:366-374.
- ⁸ Helland I, Smith L, Saarem K, et al (2003) Maternal Supplementation With Very-Long-Chain n-3 Fatty Acids During Pregnancy and Lactation Augments Children's IQ at 4 Years of Age *Pediatrics* 111, e39 –e44.
- ⁹ Richardson AJ, Montgomery P. The Oxford-Durham study: A randomized, controlled trial of dietary supplementation with fatty acids in children with developmental coordination disorder. *Pediatrics*. 2005 May; 115(5):1360-6.
- ¹⁰ Ruxton C, Derbyshire E. The latest evidence on omega-3 fatty acids and health. *Nutrition and Food Science*, 2009;39:423-438
- ¹¹ Tavazzi, L et al (2008), "Effect of n-3 polyunsaturated fatty acids in patients with chronic heart failure (the GISSI-HF trial): a randomised, double-blind, placebo-controlled trial", *Lancet*, Vol. 9645, pp. 1223-30.
- ¹² Goldberg, R.J. and Katz, J (2007), "A meta-analysis of the analgesic effects of omega-3 polyunsaturated fatty acid supplementation for inflammatory joint pain", *Pain*, Vol. 129, pp. 210-23.
- ¹³ Koch C et al (2008), "Docosahexaenoic acid (DHA) supplementation in atopic eczema: a randomized, double-blind, controlled trial", *British Journal of Dermatology*, Vol. 158, pp. 786-92.
- ¹⁴ Latest evidence on omega-3 fatty acids and health, *Nutrition & Food Science*, Vol.39 No.4, 2009, pp.423-438.
- ¹⁵ Su, KP (2009), "Biological mechanism of antidepressant effect of omega-3 fatty acids: how does fish oil act as a 'mind-body interface'?", *Neurosignals*, Vol. 17, pp. 144-52.
- ¹⁶ Hibbeln, JR (2009), "Depression, suicide and deficiencies of omega-3 essential fatty acids in modern diets", *World Review of Nutrition and Dietetics*, Vol. 99, pp. 17-30.
- ¹⁷ Issa et al (2006) "The Efficacy of Omega-3 Fatty Acids on Cognitive Function in Aging and Dementia: A Systematic Review", *Dementia and Geriatric Cognitive Disorders*, 21: 88–96
- ¹⁸ SACN (Scientific Advisory Committee on Nutrition) (2008), "The Nutritional Wellbeing of the British Population", The Stationary Office, London.
- ¹⁹ Haskell et al (2008), "Cognitive and mood effects in healthy children during 12 weeks' supplementation with multivitamins/minerals", *British Journal of Nutrition*, Vol.100, pp.1086-96.
- ²⁰ Ruxton, C. and Derbyshire, E.J. (2009), "Latest evidence on omega-3 fats and health", *Nutrition and Food Science*, Vol.39(4), pp.423-38
- ²¹ Koletzko, B et al (2010), "Dietary intake of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in children – a workshop report", *British Journal of Nutrition*, pp.1-6.
- ²² O'Sullivan TA, et al (2011). Omega-3 Index correlates with healthier food consumption in adolescents and with reduced cardiovascular disease risk factors in adolescent boys. *Lipids*; 46.
- ²³ Ruxton CHS (2011). The role of long chain omega-3 polyunsaturated fatty acids in the health of infants and children. *Complete Nutrition* 11: 15-17.
- ²⁴ Richardson AJ et al (2005). The Oxford-Durham study: a randomized, controlled trial of dietary supplementation with fatty acids in children with developmental coordination disorder. *Pediatrics*; 115:1360-6
- ²⁵ Richardson, A.J. and Montgomery, P. (2005), "The Oxford-Durham Study: a randomized, controlled trial of dietary supplementation with fatty acids in children with developmental coordination disorder", *Pediatrics*, Vol. 115, pp. 1360-6.

-
- ²⁶ Amminger, GP et al (2007), "Omega-3 fatty acids supplementation in children with autism: a double-blind randomized, placebo-controlled pilot study", *Biological Psychiatry*, Vol. 61, pp. 551-3.
- ²⁷ Gibbs et al (2010) Long-chain n-3 PUFA:intakes in the UK and the potential of a chicken meat prototype of increase them. *Proceedings of the Nutrition Society* 69: 144–55.
- ²⁸ Szajewska H et al (2006) Effect of n-3 longchain polyunsaturated fatty acid supplementation of women with low-risk pregnancies on pregnancy outcomes and growth measures at birth: a meta-analysis of randomized controlled trials. *American Journal of Clinical Nutrition* 83: 1337–44.
- ²⁹ Koletzko B et al (2008), "The roles of long-chain polyunsaturated fatty acids in pregnancy, lactation and infancy: review of current knowledge and consensus recommendations", *Journal of Perinatal Medicine*, Vol. 36, pp. 5-14.
- ³⁰ Ruxton CHS et al (2005) The impact of long chain n-3 polyunsaturated fatty acids on human health. *Nutrition Research Reviews* 18: 113–29.
- ³¹ Hibbeln, JR et al (2007), "Maternal seafood consumption in pregnancy and neurodevelopmental outcomes in childhood (ALSPAC study): an observational cohort study", *Lancet*, Vol. 369, pp. 578-85
- ³² Su KP et al (2008) Omega-3 fatty acids for major depressive disorder during pregnancy: results from a randomized, double-blind, placebo-controlled trial. *Journal of Clinical Psychiatry* 69: 644–51.
- ³³ Freeman MP et al (2006) Randomized dose-ranging pilot trial of omega-3 fatty acids for postpartum depression. *Acta Psychiatrica Scandinavica* 113: 31–5.
- ³⁴ Dunstan, JA et al (2003), "Fish oil supplementation in pregnancy modifies neonatal allergen-specific immune responses and clinical outcomes in infants at high risk of atopy: a randomized, controlled trial", *Journal of Allergy and Clinical Immunology*, Vol. 112, pp. 1178-84.
- ³⁵ Krauss-Etschmann S et al (2008), "Decreased cord blood OL-4, OL-13, and CCR4 and increased TGF- β levels after fish oil supplementation of pregnant women", *Journal of Allergy and Clinical Immunology*, Vol. 121, pp. 464-70.
- ³⁶ Dunstan, JA et al (2004), "The effect of supplementation with fish oil during pregnancy on breast milk immunoglobulin A, soluble CD14, cytokine levels and fatty acid composition", *Clinical and Experimental Allergy*, Vol. 34, pp. 1237-42.
- ³⁷ Helland, IB et al (2008), "Effect of supplementing pregnant and lactating mothers with n-3 very-long-chain fatty acids on children's IQ and body mass index at 7 years of age", *Pediatrics*, Vol. 122, pp. e472-9.
- ³⁸ Johnson et al (2006) Potential role of dietary n3 fatty acids in the prevention of dementia and macular degeneration. *American Journal of Clinical Nutrition* 83 (Suppl. 6):1494S–8S.
- ³⁹ Robinson JG et al (2010) Omega-3 fatty acids and cognitive function in women. *Womens Health* 6: 119–34.
- ⁴⁰ Morris, M.C et al (2003), "Consumption of fish and n-3 fatty acids and risk of incident Alzheimer disease", *Archives of Neurology*, Vol. 60, pp. 940-6.
- ⁴¹ Kalmijn, S. (2000), "Fatty acid intake and the risk of dementia and cognitive decline: a review of clinical and epidemiological studies", *Journal of Nutrition, Health and Aging*, Vol. 4, pp. 202-7.
- ⁴² Gibbs et al (2010), "Postgraduate Symposium: Long-chain n-3 PUFA: intakes in the UK and the potential of a chicken meat prototype to increase them", *Proceedings of the Nutrition Society*, Vol. 69, pp. 144-55
- ⁴³ Toffanello et al (2011), "Ten-year trends in vitamin intake in free-living healthy elderly people: the risk of subclinical malnutrition", *The Journal of Nutrition Health & Aging*, Vol. 15, pp. 99-103.
- ⁴⁴ Daniel, CR et al (2009), "Dietary Intake of omega-6 and omega-3 fatty acids and risk of colorectal cancer in a prospective cohort of US men and women", *Cancer Epidemiology Biomarkers and Prevention*, Vol. 18, pp. 516-25.
- ⁴⁵ Advice on fish consumption: benefits and risks. The Scientific Advisory of Nutrition and the Committee on Toxicity. London: The Stationery Office, 2004
- ⁴⁶ Advice on fish consumption: benefits and risks. The Scientific Advisory of Nutrition and the Committee on Toxicity. London: The Stationery Office, 2004
- ⁴⁷ Arterburn et al (2008), "Algal-oil capsules and cooked salmon: nutritionally equivalent sources of docosahexaenoic acid", *American Journal of Clinical Nutrition*, Vol. 108, pp. 1204-9.