In recent years, the message to “cut down on fat in the diet” has been widely quoted as one of the cornerstones of good health. However, as researchers are increasingly discovering, this simplistic message is by no means the whole story. For the fact is that certain fats are essential for our health and wellbeing, and the Omega-3 fatty acids are receiving particular attention for their beneficial properties.

Scientists first began to suspect the importance of Omega-3 (also known as n-3 fatty acids) when they studied the health of Greenland Eskimos. These people seem almost immune to heart disease, rheumatoid arthritis, asthma and many other diseases rife among industrialised nations, despite a diet that traditionally contains huge amounts of fat. However, this is made up largely of polyunsaturated fish oils and fat from fish and marine mammals, rather than saturated fat from vegetable oils and terrestrial mammals.

What is Omega-3?

Fats and oils are made up of chains of fatty acids and Omega-3 is the name given to a family of polyunsaturated fats with a long chain structure. The chain-like molecules of fats differ in the length and the number and position of bonds – or rigid links – in their structure. Saturated fatty acids are linked with single bonds. Those with one double bond are known as monounsaturated fatty acids, while those with more than one double bond are called polyunsaturated fatty acids (PUFA). The length of the chain and the number and position of double bonds determine the fat’s biological properties.

Biochemists distinguish fatty acids depending on the position of the first double bond in the chain linking the carbon atoms. So molecules with a double bond between the third and fourth carbon atom from the methyl end are called Omega-3 or n-3 fatty acids. Those with a double bond between the sixth and seventh carbon atoms are called Omega-6 or n-6 fatty acids.
Why are PUFA important to maintain health?

Fats play three key biological roles:
(1) they provide energy;
(2) they form part of the membrane surrounding each cell; and
(3) they are the precursors of chemical messengers known as prostaglandins, thromboxanes and leukotrienes (these chemical messengers control a number of important biochemical actions, including cell growth and division, blood pressure and clotting, immune reactions and inflammation).

The body makes most fat from starch and sugars; the liver, for example, synthesises the majority of the cholesterol we need. However, the body cannot synthesise polyunsaturated fats, so two of the key PUFA, linoleic acid and alpha-linolenic acid, must be obtained from our diets and are known as “essential” fatty acids. From linoleic acid, the body is in a position to make a number of Omega-6 fatty acids such as gamma-linolenic acid, dihomo-gamma-linolenic acid and arachidonic acid. Alpha-linolenic acid is the precursor of the essential Omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).

How much Omega-3 do we need?

Dietary guidelines suggest getting no more than 30 per cent of our daily calories from fat, less than 10 per cent of which should come from saturated fat. Most people living in industrialised nations eat considerably more fat than this, which leaves them vulnerable to heart disease, some cancers and non-insulin dependent diabetes.

Yet, ironically, most people do not eat enough polyunsaturated fats, particularly Omega-3. The British Nutrition Foundation has suggested that 6 per cent of dietary calories should come from Omega-6 fatty acids and 1.5 per cent from Omega-3. But what does this mean in practice?

The recommended average population daily intakes are:
(1) Linoleic acid:
   • men 17g; and
   • women 13g.
(2) Alpha-linolenic:
   • men 3g; and
   • women 2g.
(3) EPA and DHA:
   • men 1.4g; and
   • women 1.1g.

Oily fish are the richest sources of Omega-3, so eating three (200-300g) portions of oily fish – such as herring, mackerel, sardines and salmon – per week would fulfil the dietary requirements. However, in practice, many people do not like the taste of fatty fish and obtain their Omega-3 fatty acids from a combination of sources such as vegetable/rapeseed oil, chicken, beef, sweet potato and walnuts (to name but a few). Another alternative is eating processed foods – such as margarine, fat spreads and salad dressings – that have been enriched with Omega-3 or taking fish oil supplements. Modern processing technology means that these are now free of any lingering “fishy” aftertaste. Around 5g of fish oil daily meets the nutritional recommendations.

Who needs more Omega-3?

It is especially important for certain groups to ensure that their Omega-3 intake is adequate. Babies, pre-term infants and pregnant women need Omega-3 to ensure that the child develops normally. A well-nourished woman’s fat stores provide around a third of the essential fatty acids needed during the first three months of lactation. So she needs an additional 3-4g of essential fatty acids a day during this time. But she may need to boost her intake to around 5g as fat stores begin to run down.

Moreover, people with a personal or family history of heart disease or circulatory problems may reduce their risk of suffering a heart attack by increasing their intake of Omega-3. For example, some of these people exhibit high levels of a fat known as triglycerides in the blood. High triglyceride levels – a condition known as hypertriglyceridaemia – increase the risk of developing heart disease and it seems that Omega-3 fats may help to re-establish a more normal lipid profile among people with hypertriglyceridaemia. In a recent study (Eritsland et al., 1995) 4g of fish oil reduced triglycerides by 19 per cent.
Similarly, several studies suggest that people suffering from rheumatoid arthritis experience less pain and disability while taking Omega-3-rich fish oil supplements. The role of PUFA in these and other diseases is discussed in more detail below.

Do PUFAs prevent heart disease?

Epidemiological studies suggest that heart attacks, strokes and other circulatory diseases are relatively rare in societies where fish forms a major part of the diet. In Japan, for example, the more fish the person eats, the lower their risk of developing heart disease. In the Netherlands, a 20-year study found that men who ate at least 30g of fish daily were half as likely to die from coronary artery disease as those who did not eat fish (Simon, 1994). Moreover, fish and olive oil – that contains a monounsaturated fatty acid – are staple parts of the Mediterranean diet which seems to reduce the risk of heart disease among southern Europeans.

But does this mean that additional Omega-3 can reduce the risk of heart disease in countries with less fish-orientated cuisines? And is it too late to change your diet once you have already developed heart disease?

Apparently not. In fact, a growing body of evidence now suggests that Omega-3 may exert as great an effect on overall mortality as some drugs.

The DART study (Burr, 1989) investigated whether various dietary changes reduced mortality among 2,033 men aged, on average, 56 years, who had already suffered a myocardial infarction. The men received some, none or all of the following dietary advice:

• reduce fat intake to less than 30 per cent of their total energy and eat equal amounts of polyunsaturated and saturated fat;
• eat at least two portions of fatty fish weekly; and
• eat 18g of cereal fibre daily.

Only eating fish made a difference – a 29 per cent reduction in all-cause mortality over two years. The low fat diet produced only a 3-4 per cent reduction in total cholesterol and had no impact on mortality.

Simon (1994) notes that the 29 per cent reduction in all-cause mortality is greater than the 26 per cent reduction seen with beta-blockers in myocardial infarction survivors. Beta-blockers are now part of established medical therapy in these patients. However, relatively few doctors prescribe or suggest fish oils.

The results of the DART study are backed by a number of other trials. For example, fish oil supplements containing Omega-3 fatty acids inhibit restenosis (re-blockage) after coronary angioplasty (Gapinski et al., 1993). And a meta-analysis (Appel et al., 1993) revealed that, of the 11 trials that enrolled individuals with normal blood pressure, Omega-3 PUFA supplements significantly reduced systolic and diastolic blood pressure in two and one trials respectively. In the six studies of untreated hypertensives, supplements significantly reduced systolic and diastolic blood pressure in two and four trials respectively. The authors concluded that supplements containing more than 3g Omega-3 PUFA daily can reduce blood pressure among individuals with untreated hypertension.

What about rheumatoid arthritis?

Rheumatoid arthritis is a crippling and painful disease that is usually treated with non-steroidal anti-inflammatory drugs (NSAIDs). The inflammation that underlies rheumatoid arthritis is driven by two groups of chemical messengers: prostaglandins and leukotrienes. NSAIDs act by blocking the enzyme that controls synthesis of these inflammatory mediators. However, the Omega-3 PUFA EPA also reduces formation of prostaglandins and leukotrienes. And studies now suggest that, for some people at least, EPA may help alleviate rheumatoid arthritis.

For example, Lau et al. (1993) treated 64 rheumatoid arthritis sufferers with supplements containing EPA (171mg) and DHA (114mg) in each capsule. Patients took ten capsules daily, or placebo, for 12 months. All patients then took placebo for a further three months and, provided that their symptoms did not worsen, patients slowly reduced their NSAID dosage. It was found that patients taking the EPA and DHA supplements reduced their NSAID dosage to a greater extent than those on placebo. The improvement was most marked after a year and was maintained to 15 months.
Furthermore, a meta-analysis found that three months’ fish oil supplementation significantly reduced tender joint count and morning stiffness compared to control oils (Fortin et al., 1995).

Indeed, PUFA proved to be as effective as NSAIDs in a study conducted by Kremer et al. (1995). Patients who were taking diclofenac for rheumatoid arthritis were given either 130mg per kg daily Omega-3 fatty acids or nine capsules of corn oil daily. The group receiving fish oil reported fewer tender joints and a shorter duration of morning stiffness. Both physicians’ and patients’ evaluation of global arthritis activity and physicians’ evaluation of pain improved among patients taking fish oils. In contrast, patients taking corn oil showed no improvement. Moreover, patients taking fish oil continued to have fewer tender joints after discontinuing diclofenac. Finally, levels of interleukin-1 beta decreased significantly between weeks 18 and 22 in patients who consumed fish oil, thus providing some objective evidence that Omega-3 PUFA may reduce the underlying disease process in rheumatoid arthritis.

Infant nutrition

The importance of certain fats in normal growth and development first emerged in 1929 when rats fed a fat-free diet showed retarded growth, impaired kidney function, were unable to reproduce and lost excessive amounts of water. In the 1960s, children fed formula feeds deficient in Omega-6 PUFA developed skin diseases and retarded growth.

During the 1980s, paediatricians began to recognise the signs of Omega-3 deficiency – abnormal vision, impaired brain function and peripheral neuropathy. Indeed, DHA comprises half the total fatty acid in the phospholipids in the brain and retina.

So pregnant women need to get adequate amounts of PUFA – especially during the third trimester when neural growth is most marked. Babies also require relatively high levels of Omega-3, which they obtain ideally from breast milk or, in the case of premature babies, from fortified formula feed. As a result, pregnant and lactating women may become relatively deficient in Omega-3 and need to increase their intake. Premature babies are particularly vulnerable to Omega-3 shortages as they have low fat reserves at birth.

Some new areas of research

Dermatology

The key role played by PUFA and their ultimate products, such as prostaglandins and other inflammatory mediators, led to studies investigating their role in other inflammatory diseases. For example, PUFA – especially Omega-6 fatty acids – help keep skin healthy, smooth and supple. This protects the skin from injury and infections and regulates body temperature and water loss. In psoriasis, fish oils lessen itching and inflammation. Essential fatty acids also seem to exert an anti-inflammatory action in infantile seborrhoeic dermatitis and diaper dermatitis.

Lung disease

The possibility that PUFA may protect smokers from chronic obstructive pulmonary disease (COPD) was investigated by Britton (1995). He postulated that Omega-3 fatty acids reduce prostaglandin and leukotriene synthesis, inhibit the migration of pro-inflammatory neutrophils into the lung and reduce the lungs’ response to allergens. It has also been observed that lung function is lower and COPD more common among people who eat less fish.

Nevertheless, the benefits may only extend to certain groups of patients and these findings need confirmation in further studies, although a link between PUFA and other lung disease is also emerging.

Gastro-intestinal disease

Crohn’s disease is a chronic, relapsing, inflammatory disease of the gastro-intestinal tract. In some patients, the inflammation spills over from the lining of the gastro-intestinal tract, triggering inflammatory diseases in other parts of the body such as the eyes, joints and skin. Studies now suggest that Omega-3 fatty acids may reduce the likelihood of relapse. As many of the treatments used for Crohn’s disease are toxic, this marks an important advance.

What next on Omega-3?

Research into the health benefits of Omega-3 is continuing across a diverse range of therapeutic areas – from diabetes, multiple sclerosis and migraine to depression and cancer. As this research progresses,
opportunities to increase our dietary sources of Omega-3 fatty acids are also being explored further.

One particular area of interest is the role that “functional foods” – i.e. foods defined as having a health-promoting benefit – can play. The ability to add fish oils rich in Omega-3 fatty acids to foods without the “fish taste” is possible with the use of highly refined or microencapsulated fish oil. A range of products, including breads and eggs, have already taken advantage of this new technology, and further Omega-3 fortified foods are anticipated in the near future.

It is clear that Omega-3 fatty acids will continue to play a vital health-promoting role in our diet. And, to this end, maintaining and raising awareness of the health benefits of this essential nutrient will remain key among both health-care professionals and the general public alike.

References


