Omega-3 Fatty Acids and Cardiovascular Disease

Background

The cardiovascular system (CVS) has spoken; there are good fats and there are bad fats. Trans-fats, produced artificially, are bad in any amount, while intake of saturated fats, from animal products, should be kept as low as possible. The good, polyunsaturated fats are required by the CVS for optimal functioning. The best polyunsaturated fats are those that contain the essential fatty acids (EFAs). These are fatty acids that the body cannot produce and therefore a regular, sufficient supply is required from our diet for optimal functioning and health. Research has suggested that by increasing the intake of the EFA, omega-3 (n-3), we may actually prevent and/or reduce our risk of developing various chronic diseases such as arthritis and neurological disease. This article provides a brief introduction to n-3 fatty acids and specifically focuses on the possible role of n-3 in preventing certain cardiovascular conditions.

What are Omega-3 Fatty Acids?

The two families of EFAs are n-3 and omega-6 (n-6). α-linolenic acid (ALA) is the primary n-3 EFA, and linoleic acid (LA) is the primary n-6 EFA. The initial interest in n-3 fatty acids and the CVS stemmed from research performed in the 1970s with Greenland Eskimos. The researchers found that despite these Eskimos consuming a diet high in fat, they had a low rate of coronary heart disease (CHD). Further research discovered that two of the fats they consumed in large quantities, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were providing the cardio-protective benefits. EPA and DHA are both members of the n-3 fatty acid family. The human body cannot synthesise n-3 fatty acids from scratch, but can synthesise EPA and DHA from the n-3 fatty acid ALA. Therefore, ALA is an essential nutrient which must be obtained from food, and EPA and DHA which can be either synthesised from ALA within the body, or obtained from food, are sometimes also referred to as essential nutrients.

Food Sources of Omega-3 and Omega 6 Fatty Acids

The main food sources of n-6 fatty acids are vegetable/seed oils such as sunflower, safflower, peanut, cottonseed, grapeseed, canola, soybean and corn oils that contain a high proportion of LA. Sources of n-3 fatty acids, specifically ALA, include flaxseed oil, canola oil, soy oil, baked beans, walnuts and most dark leafy vegetables. ALA is not found in fish, although as indicated earlier, it has the potential to be converted to EPA and DHA. The marine n-3 fatty acids, EPA and DHA, are found mainly in oily fish such as salmon, sardines, herring, mackerel, trout and tuna. In general, the ‘oilier’ the fish the greater their concentration of EPA and DHA.

Cardio-protective Benefits of EPA and DHA: Controversy

Since 2004, the United States Food and Drug Administration has promoted the intake of EPA and DHA, suggesting that these n-3 fatty acids may reduce the risk of CHD. However, recent research has been somewhat conflicting regarding the cardio-protective benefits of n-3 fatty acids.

A study in the British Medical Journal in April 2006, reviewing almost 100 separate studies into oily fish n-3 fatty acids, concluded that they do not have significant protective effect against CVD. In contrast, two different reviews also published in 2006, in the American Journal of Clinical Nutrition and JAMA both reported decreases in total mortality and cardiovascular incidents (i.e. myocardial infarctions) associated with the regular consumption of fish and fish oil supplements.

Omega-3 and Cardio-protection: Mechanisms of Action

Research has demonstrated multiple mechanisms that may explain the cardio-protective benefits of n-3 fatty acids. Firstly, n-3 fatty acids have been shown to reduce the risk of sudden cardiac death through decreasing susceptibility to developing ventricular arrhythmias that lead to tachycardia. Secondly, n-3 fatty acids have been shown to enhance contractility as well as reduce the severity of damage caused to the myocardium by ischemic stress. Thirdly, n-3 fatty acids reduce the risk of developing CVD by altering blood lipid levels. Specifically, they reduce fasting and postprandial triglyceride levels by 20% to 35% by suppressing hepatic very low density lipoprotein (VLDL)-triglyceride production. In addition, they accelerate clearance of chylomicron triglycerides. They have also been shown to increase circulating levels of high density lipoprotein (HDL), the good cholesterol. In addition, n-3 fatty acids exhibit anti-inflammatory...
properties, reducing inflammatory damage to vessel walls, and may also improve arterial wall compliance (improved ability to vasodilate). Both these mechanisms are cardio-protective. Finally, proposed mechanisms that may also explain the cardio-protective properties of n-3 fatty acids include: a reduction in platelet aggregation, decreased heart rate, improved ventricular diastolic filling, blood pressure reduction, and stabilisation of existing arterial plaques. However, all these mechanisms still need further research to determine which effects truly predominate in individuals consuming n-3 fatty acids.

**Supplement Strategies and the Omega-6 to Omega-3 ratio**

Fats are macronutrients and therefore not assigned recommended daily allowances (RDAs). Rather, fats have been assigned Acceptable Intake (AI) levels with the AI for n-3 being 1.6 grams/day for men and 1.1 grams/day for women. n-6 and n-3 fatty acids act very differently in the body in relation to the cardiovascular system. Research has shown that one of the n-6 fatty acids, arachidonic acid, is converted into various molecules called eicosanoids. The n-6 eicosanoids family (prostaglandins, thromboxanes, prostanoylins, and leukotrienes) are pro-inflammatory and are therefore essential for optimal immune function in the body as well as other important biological functions. Researchers believe the ideal n-6 intake should be no more than 4-5 times that of the n-3 intake. Specifically, the ideal ratio of n-6 to n-3 in an average Western diet should range from 3:1 to 1:12.

This is in contrast to the current Western diet that on average has an n-6:n-3 ratio of 17:1. The National Institutes of Health in the United States recently published recommended daily intakes of fatty acids. Specific recommendations include 650 mg of EPA and DHA, 2.22 g/day of ALA and 4.44 g/day of LA. These recommendations ensure that the n-6 to n-3 ratio is in the optimal range.

**Potential Adverse Effects**

An important finding from the 2006 reviews that published positive effects of n-3 fatty acids on cardiovascular health was that there were no or very few complications associated with n-3 supplementation. However, the following potential adverse effects of n-3 supplementation should be noted:

There is a risk of heavy metal poisoning due to the presence of contaminants such as methyl-mercury in some fish/fish oil. For these reasons, the FDA recommends that total dietary intake of n-3 fatty acids from fish be limited to 3 grams per day, of which no more than 2 grams per day are from nutritional supplements.

In addition, suspected risks of EPA and EHA n-3 fatty acid supplementation have been reported to be: increased bleeding if overused (normally over 3 grams per day), haemorrhagic stroke, oxidation of n-3 fatty acids forming biologically active oxidation products, increased levels of low density lipoproteins (LDL) among diabetics and hyperlipidemics, reduced glycemic control among diabetics, suppression of immune and inflammation responses.

Finally, it has been suggested that individuals with congestive heart failure, angina or evidence that their heart is receiving insufficient blood flow, speak to their doctor before taking n-3 fatty acid supplementation. Recent evidence has indicated that n-3 fatty acids may be detrimental to such patients, although further research is required.

**Conclusion**

Dietary supplementation with the n-3 fatty acids ALA, EPA and DHA is more than a “fad” and will increase in the future due to more and more research demonstrating their positive impact on the health and functioning of the CVS. In addition, the specific properties of n-3 fatty acids have also been shown to have potential for impact on a variety of diverse chronic diseases, such as arthritis, cancer, depression, maternal and child health, neurological diseases and osteoporosis. The future therefore seems bright for n-3 fatty acids.

**References**