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Polyunsaturated Fatty Acids and Their Effects on CardiovascularDiseases

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Abstract
Dietary polyunsaturated fatty acids (PUFAs) affect a wide variety of physiological processes. Much attention has been given to the n-3 PUFAs and their role in the prevention and treatment of cardiovascular disease, stemming from evidence obtained through a number of epidemiological studies and clinical trials. Investigators are now focused on elucidating the pathways and mechanisms for the biological action of n-3 PUFAs. Dietary intervention is recognized as a key measure in patient therapy and in the maintenance of human health in general. PUFA probably slightly reduces fats circulating in the blood (cholesterol, high‐ quality evidence and triglycerides, moderate‐quality evidence). Increasing PUFA probably slightly increases body weight (moderate‐ quality evidence). The evidence mainly comes fromtrials of men living in high‐ income countries.
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I. Introduction

Fats are essential for living organisms. Fatty acid (FA) molecules have a variable length carbon chain with a methyl terminus and a carboxylic acid head group (**Holub, 2016)**. They can be categorized based on the degree of saturation of their carbon chains. Saturated FAs possess the maximal number of hydrogen atoms, while monounsaturated FAs and polyunsaturated FAs (PUFAs) have one, or two or more, double bonds, respectively. PUFAs can be further subdivided on the basis of the location of the first double bond relative to the methyl terminus of the chain. For example, n-3 and n-6 FAs are two of the most biologically significant PUFA classes, and have their first double bond on either the third or sixth carbon from the chain terminus, respectively. The final carbon in the FA chain is also known as the omega carbon, hence the common reference to these FAs as omega-3 or omega-6 PUFAs **(Lanzmann, 2017**).

Long-chain n-3 and n-6 PUFAs are synthesized from the essential FAs (EFAs) alpha- linolenic acid (ALA) and linoleic acid, respectively. An EFA cannot be made by the body and must be obtained through dietary sources. Animals and humans have the capacity to metabolize EFAs to long-chain derivatives **(Dolecek, 2010).** Because the n-6 and n-3 pathways compete with one another for enzyme activity, the ratio of n-6 to n-3 PUFAs is very important to human health. An overabundance of FAs from one family will limit the metabolic production of the longer chain products of the other. The typical Western diet provides n-6 and n-3 PUFAs in a ratio ranging from 8:1 to 25:1 values in severe contrast with the recommendations from national health agencies of approximately 4:1 (**(Singh, *et al.*, 2018**),). Lowering the n-6:n-3 ratio would reduce competition for the enzymes and facilitate the metabolism of more downstream products of ALA. Because most diets are already very rich in n-6 PUFAs, greater focus needs to be placed on incorporating n-3 PUFAs into the diet. Dietary sources of n-3 PUFAs are readily available but in limited quantities. Many foods contain ALA, including certain vegetable oils, dairy products, flaxseed, walnuts and vegetables **(Harris, *et al.*, 2010).** Fatty fish, such as mackerel, herring and salmon, provide an excellent source of the long-chain derivatives of ALA, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (**Holub, 2016).**

EFFECTS OF PUFAs ON CARDIOVASCULAR DISEASE

Antiatherogenic effects of n-3 FAts

Atherosclerosis is an inflammatory disease of the vascular system. Dietary factors play a significant role in the development of atherosclerosis. Consumption of long-chain n-3 PUFAs demonstrated antiatherogenic effects in experimental and epidemiological studies (**Albert, *et al.*, 2015).** The recent Study on Prevention of

Coronary Atherosclerosis by Intervention with Marine Omega-3 FAts SCIMO demonstrated that consumption of 1.65 g/day of a fish oil supplement by patients with CAD resulted in less progression and more regression of coronary atherosclerotic plaques **(Garry, *et al*., 2019).** However, this effect was not observed in the carotid arteries, suggesting that n-3 PUFAs may have different effects in different vascular beds (**Renier, *et al.,* 2018).** The only study to show a negative effect of fish consumption on CAD was conducted in Finland, but these results may have been influenced by mercury contamination of the fish **(Von Schacky, *et al.,* 2015**). n-3 PUFAs provide their antiatherogenic effects through one or a combination of several potential mechanisms. They may exert their effect on atherogenesis by altering the circulating lipid profile; changing the physicochemical function of cell membranes, thereby affecting eicosanoid biosynthesis, cell signalling and gene expression; and modulating vascular smooth muscle cell proliferation andmigration (**Harris, 2016**).

Nilsen *et al* showed a significant decrease in total cholesterol and a significant increase in HDL cholesterol after fish oil supplementation. The concomitant increase in HDL cholesterol levels relative to increasing LDL cholesterol often leaves the total cholesterol to HDL cholesterol ratio, a common measure of atherogenic risk, unchanged. This evidence suggests that n-3 PUFAs reduce atherosclerotic development through mechanisms other than lowering LDL cholesterol **(Nilsen *et al*., 2012**). The increase in LDL cholesterol levels from n-3 PUFA supplementation appears to be due to an increase in LDL particle size rather than to the number of LDL molecules. n-3 PUFAs modify the composition of LDL cholesterol by increasing apolipoprotein B and decreasing lipoprotein levels, resulting in a less atherogenic molecule**(Dewailly, *et al.,* 2014**). The hypotriacylglycerolemic effect and the consequent increase in LDL cholesterol observed with n-3 PUFA supplementation may be due to altered very low density lipoprotein (VLDL) metabolism. A recent dietary intervention trial confirmed that n-3 PUFAs decreased plasma TG and VLDL apolipoprotein B levels. The VLDL pool size decreased due to a reduction in hepatic secretion of VLDL and increased conversion of VLDL to LDL **(Adler, 2013).**

Effects of n-3 PUFA:

Increased intake of EPA and DHA inevitably results in greater incorporation of these FAs into circulating lipids and into tissues. n-3 PUFAs may replace n-6 PUFAs in cell membrane phospholipids, thus altering the physicochemical properties of the membrane **(Roth, et al., 2019)**. The physicochemical alterations in membrane properties may directly or indirectly influence the function of membrane-bound receptors, ion channels and enzymes, and affect downstream signalling pathways that will have a direct effect on vascular endothelial and smooth muscle cell function. Eicosanoid production is also affected by the FA composition of the membrane. Studies indicate that omega-3s can improve bone strength by boosting the amount of calcium in your bones, which should lead to a reduced risk of osteoporosis. Omega-3s may also treat arthritis. (**Booth, 2016**).

Effect of omega-6 PUFA:

Omega-6 fatty acids are a type of polyunsaturated fat found in vegetable oils, nuts and seeds. When eaten in moderation and in place of saturated fats, omega-6 fatty acids can be good for the heart and appear to protect against heart disease.Cardiovascular disease (CVD) is considered to be the major cause of death globally. Several risk factors, such as smoking, dyslipidemia, hypertension, obesity, a sedentary lifestyle, and ethnicity, are closely related to CVD risk. It is worth mentioning that up to 90% of CVD cases may be preventable by considering behavioral risk factors **(Nestel, 2013).** Omega-6 fatty acids play a crucial role in brain function, and normal growth and development. As a type of polyunsaturated fatty acid (PUFA), omega-6s help stimulate skin and hair growth, maintain bone health, regulate metabolism, and maintain the reproductive system.Furthermore, CVD is closely linked with diet and dietary factors (**Russo, 2012**). Omega-6 (or n-6) polyunsaturated fatty acids (PUFAs) play an important role in a wide range of physiological functions. In this context, linoleic acid (LA, 18:2, n-6), the shortest-chained omega-6 fatty acid, is an essential fatty acid since it is not synthesized by the human body and must be obtained through the diet (e.g. vegetable oils, nut oils, poultry, meet, egg, milk, and margarines. Adrenic acid (AA, 22:4, n-6) is another omega-6 PUFA, which can be synthesized from LA in the human body. A diet high in omega-6 can increase the production of vasoconstricting eicosanoids which may promote increases in blood pressure (**Kaduce, *et al.,* 2015)**.

II. Conclusion

Polyunsaturated fat is a type of dietary fat. It is one of the healthy fats, along with monounsaturated fat. Polyunsaturated fat is found in plant and animal foods, such as salmon, vegetable oils, and some nuts and seeds. Eating moderate amounts of polyunsaturated (and monounsaturated) fat in place of saturated and trans fats can benefit your health since saturated fat and trans fat can increase the risk for heart disease and other health problems. Polyunsaturated fats can help lower the LDL (bad) cholesterol. Cholesterol is a soft, waxy substance that can cause clogged or blocked arteries (blood vessels). Having low LDL cholesterol reduces your risk for heart disease. Polyunsaturated fats include omega-3 and omega-6 fats. These are essential fatty acids that the body needs for brain function and cell growth. Omega-3 fatty acids may decrease the chance of the heart having an abnormal rhythm. Omega 3- fatty acids may also increase compliance of arteries, decrease atherosclerosis through their effects on metabolism, and reduce inflammatory markers in the body. HDL indicates high-density lipoprotein. Omega-6 fatty acids are a type of polyunsaturated fat found in vegetable oils, nuts and seeds. When eaten in moderation and in place of saturated fats, omega-6 fatty acids can be good for the heart and appear to protect against heart disease.

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