Omega 3 Fatty Acids, Inflammation, and Cardiovascular Diseases Prevention—An Essay

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Abstract

This is an essay focused on discussing parts of the current state of knowledge and research in the field of Omega 3, Inflammation and cardiovascular diseases prevention. For a long time, Omega 3 has been considered a health-promoting and beneficial substance for well-being and longevity. New studies have shed new light on the role of omega 3 in cardiovascular diseases prevention and anti-inflammatory effects.

Keywords

1. Introduction

In this paper the current knowledge and a general review of Omega 3 fatty acids and their role in cardiovascular diseases and prevention will be reviewed.

Omega 3

Omega-3 fatty acids are found in fatty fish and in some nuts and seeds. These good fats can reduce blood pressure, decrease triglyceride levels, slow the growth of plaque in the arteries and reduce the risk of arrhythmias. Doctors may prescribe an Omega-3 supplement if you're on a heart patient diet but you should also be eating Omega-3-rich foods such as:

1) Salmon;
2) Tuna;
3) Herring;
4) Sardines;
5) Walnuts.

Interestingly, Omega-3 oil (which as mentioned is contained for instances in fish and nuts) aids in increasing the levels of High-Density Lipoproteins (HDL) and in reducing the levels of cholesterol.

2. Cardiovascular System, Metabolic Syndrome and Omega-3

The cardiovascular system is an intricate apparatus which includes a pump, being the heart, and the vasculature, which grossly one can say it includes the arteries, veins and capillaries. Already in the 1600s, Dr. William Harvey first proposed the circulation of blood in the body in his most illustrious work "De Motu cordis" (the motion of the heart).

As a matter of fact, it is thanks to this system that we humans are able to function and operate.

Many of the diseases affecting the cardiovascular system are preventable by implementing a correct and healthy lifestyle [1].

The heart has four chambers, two ventricles and two atria. It pumps the blood throughout the body, which flows throughout a system of pipes known as arteries and veins.

The microcirculation (including terminal arterioles, metarterioles, venules and capillaries with the lymphatic capillaries) also plays an important role, as it serves mainly to deliver oxygen, nutrients, remove carbon dioxide and regulate inflammation and edema formation.

In the arteries, there can be an abnormal accumulation of macrophages, lipids, debris, calcium and fibrous connective tissue which is called atheromatous plaque. It can occlude different arteries at different levels (a decrease in the lumen is known as stenosis). If a critical stenosis occurs in the coronary system, this could complicate into a myocardial infarction, a heart attack.

Cholesterol-panel levels, including Low Density Lipoproteins (LDL), are predictive of cardiovascular diseases such as ischemic coronary syndromes.

Various molecules are implemented as a medical therapy for cholesterol level reduction, including: statins (HMG-CoA Inhibitors), Ezetimibe (acting on the intestinal absorption) and the novel monoclonal antibodies such as Evolocumab which blocks the hepatic protein called PCSK9 interfering with the binding of LDL to these superficial liver proteins.

Interestingly, Omega-3 oil (contained for instances in fish and nuts, therefore being available both of animal origin and vegetal origin) aids in increasing the levels of High-Density Lipoproteins (HDL) and in reducing the levels of cholesterol [2] [3]. Furthermore Omega 3 fatty acids play an important role in modulating inflammation, by reducing inflammation markers [4] [5]. When talking about omega 3, it must also be noted the supplementation of Omega 3 fatty acids has notable blood-thinning (anti-coagulant) effects.

Also, the isomer Trans-Resveratrol, contained in grape seeds for instance, has shown to be beneficial in reducing the risk of cardiovascular event and acting on

the Sirtuin-group of genes (eg. Sirt 7), thus counteracting some physio-pathological effect of aging.

This goes to further show the massive impact of lifestyle on cardiovascular disease, demonstrating how diet can impact the body to a genetic level, giving a stronger base to which lay the foundations of the "healthy diet" concept.

When discussing diet and its impact on ageing, one must first consider ageing as a multifactorial process which the human body undergoes. Ageing involves various processes. Inflammation, which is a multifaceted process, which can be acute, sub-acute or chronic, and vital for the human body to survive and fight off diseases or infections but which can be detrimental and cause of diseases. As a matter of fact, the silent chronic inflammation is a leading cause of diseases and often times goes hand-in-hand with ageing. This process is correlated with several pathologies such as stroke, myocardial infarction, neurological disease and oncological disease. Triggers of this type of inflammation include lifestyle and diet.

Glycation is another major point when talking about the ageing process, cardiovascular diseases and diet. It is a biochemical reaction dependant on the presence and concentration of glucose in blood, of proteins and of the permeability of cells to glucose. The results of this process are the glycotoxins, which alter the tissues characterisation and bring about AGE (Advances Glycation End-products), causing inflammation and ROS (reactive oxidative species) producing processes.

Another process worth mentioning is the methylation of DNA, physiological and necessary in the formation and reparation of DNA and in some types of gene silencing processes. It is involved in the production of various macromolecules such as lipids, neurotransmitter, proteins, hormones and nerve's myelin sheaths. However, when this process changes, in turn affecting the epigenetic landscape of human DNA, can have detrimental effect on the human body. For instance a downstream effect of altered methylation process is the increase in Homocysteine level, causing an increase risk of cardiovascular diseases such as stroke (homocysteine is considered an independent risk factor for atherosclerosis and it has been shown to induce inflammatory response in vascular smooth muscle cells [6].

Oxidative stress can induce an increase in ROS production, both from endogenous (such as obesity or diabetes mellitus) and exogenous causes.

Regarding the measurement of stress, quantitatively blood cortisol level could be a good mean in certain categories of population, together with its axis (ACTH). But also DHEA and sex hormones together with urinary catecholamines and glycemic could be other good serological markers for stress.

Basal and under-stimulus biofeedback is a further method to measure stress by measuring galvanic resistance on the skin.

Diet is fundamental for a correct and balanced lifestyle. For instance, processed meat, nitrites rich foods (together with other cancerogenic preservers),

lead rich vegetables, burnt food (which can be rich in some instances of acrylamide—a cancerogenic substance). Therefore, there are certain foods which are deleterious and, in some instances, if chronically consumed could lead to serious pathologies.

A healthy diet would necessary consist of fruits and vegetables (prepared with healthy cooking methods, as like hinted before, these can strongly affect the proprieties of foods that we consume). Lipids, preferably of rich in unsaturated fats and low in saturated fats. White meats and fish (and when eating meat it would be best if these animals were to grow and live in the open, grass-fed and without being filled of the heavy use of antibiotics). This would also allow for a better control of cholesterol levels, aiding in the prevention of atherosclerosis.

A strong point, at times forgotten, is the use of pesticides in our food. Thus trying to eat organic food would truly guarantee the healthy benefits of the products we eat daily.

Regarding condiments, salt monitoring must be done and observed in our everyday life, and not simply the salt we add ourselves, but also the one contained in many pre-made foods we buy.

Digestion starts in the mouth. It is important to remind ourselves to chew foods in our mouth (15 to 30 times) for the enzymes in our saliva and for the mechanical grinding to star the proper digestion process.

With the advent of new technologies, we found ourselves being able to live longer lives. The importance of the quality of life has never been as important as now.

It is important to categorise foods also as functional foods, with clear benefits to our body. These include superfoods like Green Tea and garlic. To use these foods, commonly used in different cultures and past rural populations, showed the amazing benefits of these superfoods and a need to indeed go back to a more rural lifestyle, including physical activity and healthier diet (more distant to fast foods and processed foods and closer to raw prime materials with which to cook in healthy ways).

Regarding diet and cardiovascular diseases (CVD), the connection has been hinted in previous chapters. One of the most important effects is the diet and cholesterol, a strong and long-known relationship.

A healthy diet must necessarily contain the five main food groups.

1) Vegetables-legumes;

2) Fruit;

3) Grain (cereal);

4) Lean meats/Poultry/Fish/Eggs;

5) Milk/Yoghurt/Cheese or Alternatives (Mostly all of these with reduced-fat content).

It is important to cut back from restaurants and take-out meals as much as possible. These foods are often times rich in salts, preservative, trans-saturated fats and refined sugars, all of which are detrimental to both cardiovascular health

and overall body physiology.

An important tip token in mind is the following. Eat like a king in the morning (which is the time you need energy and nutrients to face the day).

Eat a balanced and nutrients-filled lunch (which will sustain you for the remainder of the day and keep your body going).

Eat a very light dinner (not too late, around 6 pm, allowing your body to digest and go to bed light—which will also help against Gastro-esophageal reflux GERD).

Foods and drinks like soft drinks, sodas and confectionaries are many times high in glycemic value and calories. This might lead to overweight and obesity (a true epidemic in many countries) causing terrifying effects on the human body. We as humans have forgotten how an excessive intake of food combined with an astounding decrease in physical activity, which unfortunately has been recorded in many countries around the globe, can have a destructive, and perhaps one of the most preventable, effects.

This leads to the metabolic syndrome. If there ever was a period in time where to talk about this syndrome, this is it. When we physician refer to the metabolic syndrome, we refer to the medical term with which we describe the combination of diabetes mellitus, hypertension (high arterial blood pressure) and obesity.

This syndrome puts a person at a much-increased risk of cardiovascular diseases such as coronary artery disease (increased risk of Myocardial Infarction—Heart attack) and stroke.

These conditions included in the metabolic syndrome are in fact oftentimes linked (data from the nhs in UK showed that they affect 1 in 3 adults older than age of 50 in UK).

Symptoms of the metabolic syndrome include:
- High blood triglycerides level and low HDL levels (risk factor for atherosclerosis);
- High arterial blood pressure (often consistently 140/90 mmHg);
- Waist circumference above 94 cm for men and 80 cm for women (European populations);
- Inability to control blood sugar levels (signs of Insulin Resistance, an alarm bell for the development of Diabetes Mellitus Type II);
- Increase risk of developing blood clots (eg. Deep vein thrombosis—DVT);
- Increase inflammation.

The causes of metabolic syndrome include being overweight or obese (with lack of exercise), age, insulin resistance and the presence of diseases (such as non-alcoholic liver disease, polycystic ovary syndrome and cardiovascular diseases).

Therefore, is it possible to prevent or reverse the metabolic syndrome? The answer is yes!

It includes mostly changes in lifestyle, including: increasing isotonic physical exercise, eating a healthy diet (low in salt, low in saturated fats and low in re-

fined sugars), quitting smoking and drinking alcoholic beverages. Also, under the counsel of your personal physician, medical therapy can be implement.

We live in a much different society than our forefathers. Food is more accessible and with the advent of cheap and worldwide distributions, fast-food aliments have become widespread and consumed by most of the families in the different continents.

This aspect has especially affected the young generations leading to the next aspect discussed in this essay, Childhood obesity. This issue has become one of the most serious public health issues of this century.

The prevalence of obesity (and overweight) in adolescents is classified according to the World Health Organisation growth reference for school-aged children and adolescents (namely 2 and 1—for obesity and overweight-standard deviations of body mass index BMI for sex and age). This issue is ever increasing and affects many low- and high-income countries. In 2016, the number of overweight children under the age of five has been estimated to be forty-one million. These children are more likely to stay overweight and obese during their adult life, this leading to a plethora of preventable conditions such as cardiovascular diseases and diabetes mellitus type two at a very young age.

It is also of importance to note that approximately two and half million people die yearly due to overweight and obesity complications. In fact, these individuals are not only at higher risk of developing certain type of cancers (such as endometrial, breast and colon cancer) and osteoarthritis.

In our societies there has been a clear shift to a very energy rich diet, filled with saturated fats, refined sugars and salt. This together with a marked decrease in physical activity, is leading to a true pandemic condition which is affecting our future generations and remodeling our very own society, including the public health aspects of various countries.

More so than adults, children need a further specialized attention when it comes to the fight of obesity and overweight, involving also the teaching of the short-term and long-term consequences of this type of lifestyle.

As we are nearing the conclusion to this essay, it is worth noticing a final concept. Despite the last decades reduction in aged-adjusted mortality, in 2013 cardiovascular disease (CVD) was the leading cause of death in the United States (as a matter of fact, CVDs have been a leading cause of death in the United States for the last one hundred years). These cardiovascular diseases include: coronary artery diseases (the most common), cerebrovascular diseases (strokes), peripheral arteries diseases and other plentiful conditions included in this umbrella term.

It is very important to note that many conditions included in the term cardiovascular diseases are preventable. And this brings us to Primary and Secondary prevention methods of cardiovascular diseases. When talking about Primary prevention, it is important to notice that the group of target patient is the group with no cardiovascular diseases in which aim is to prevent the onset of these.

While, when talking of secondary prevention measures the target patient group is a group of patients with a cardiovascular disease where the aim is to prevent the onset of new CVDs and the worsening of pre-existing ones. Both deal with the plethora of aspects and "weapons" that the medical community has in its arsenal when it comes to fight this crippling public health burden. Namely: lifestyle changes, medications (such as treating hypertension, also with multi-drug regimen, and treating dyslipidemia).

A milestone study which completely changed theway the scientific community looked at Omega-3 was the GISSI-Prevenzione [7]. The scientists who participated at this study concluded that n-3 polyunsaturated fatty acids (PUFA) resulted in a clinically important benefit, being the following: 20% reduction in cardiovascular deaths, 23% reduction in cardiac death, 25% reduction in coronary death, 35% reduction in sudden death, despite the primary endpoint not being statistically significant. Furthermore it was revealed that vitamin E had no benefit after myocardial infarction.

3. Conclusion

Omega 3 fatty acids are a staple for a healthy diet. Their role in cardiovascular diseases prevention has been shown in several studies across the years and they therefore must become a vital part of the diet (which can be included also in vegetarian-based diets).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Domenico, S. and Sarandria, N. (2021) 21st Century Bakemono: An Essay on Diet, Cardiovascular Diseases and Aging. KD Publishing, Seattle.

[2] Freitas, R. and Campos, M. (2019) Protective Effects of Omega-3 Fatty Acids in Cancer-Related Complications. *Nutrients*, **11**, 945.
https://doi.org/10.3390/nu11050945

[3] Nabavi, S.F., Bilotto, S., Russo, G.L., Orhan, I.E., Habtemariam, S., Daglia, M., Devi, K.P., Loizzo, M.R., Tundis, R. and Nabavi, S.M. (2015) Omega-3 Polyunsaturated Fatty Acids and Cancer: Lessons Learned from Clinical Trials. *Cancer Metastasis Reviews*, **34**, 359-380.

[4] Kiecolt-Glaser, J., Belury, M., Andridge, R., Malarkey, W. and Glaser, R. (2011) Omega-3 Supplementation Lowers Inflammation and Anxiety in Medical Students: A Randomized Controlled Trial. *Brain, Behavior, and Immunity*, **25**, 1725-1734.
https://doi.org/10.1016/j.bbi.2011.07.229

[5] Ishihara, T., Yoshida, M. and Arita, M. (2019) Omega-3 Fatty Acid-Derived Mediators that Control Inflammation and Tissue Homeostasis. *International Immunology*, **31**, 559-567. https://doi.org/10.1093/intimm/dxz001

[6] Pang, X.M., Liu, J.T., Zhao, J.J., *et al.* (2014) Homocysteine Induces the Expression of C-Reactive Protein via NMDAr-ROS-MAPK-NF-κB Signal Pathway in Rat Vas-

cular Smooth Muscle Cells. *Atherosclerosis*, **236**, 73-81.
https://doi.org/10.1016/j.atherosclerosis.2014.06.021

[7] Jialal, I., Devaraj, S., Huet, B. and Traber, M. (1999) GISSI-Prevenzione Trial. *The Lancet*, **354**, 1554. https://doi.org/10.1016/S0140-6736(99)90191-5