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Review Article

An assessment on cholesterol: A vital component for human health

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ABSTRACT

A vital chemical in humans, cholesterol can cause sickness when it is present in excess or insufficiently. Numerous articles exist that address dietary cholesterol, including the well-established link between it and the most prevalent diseases, as well as the issue of diet recommendations that are always changing. Noncompliance in the general population is the main cause of concern when it comes to cholesterol consumption. On the other hand, cholesterol is just as vital to the human body as any other nutrient. Understanding the advantages and risks of cholesterol from a scientific standpoint will improve our capacity to manage illnesses linked to this special molecule.

1. Introduction

Cholesterol is a type of fat that gets transported by the circulatory system and can be detected in several tissues throughout the body. With a hydrocarbon tail, a core sterol nucleus composed of four hydrocarbon rings, and a hydroxyl group, this molecule has a distinctive structure and comprises twenty-seven carbon atoms. All hormones containing steroids have a core sterol centre or loop. Since the core ring and the hydrocarbon tail are inert, they cannot mix with water. As a result, cholesterol (a lipid) is bundled with apoproteins (a protein) to be transported through the bloodstream as a lipoprotein. Humans are capable of producing cholesterol through fresh synthesis within the body as well as through nutrition. The liver and intestines, which together account for around 10% of the body's total cholesterol, are the sites of fresh cholesterol production. The walls of cells in every region of the body, but particularly in the nervous system, contain what are known as lipid molecules. Both the liver and adipose tissue store it. In the liver, Apo proteins bundle dietary triglycerides, cholesterol, and extremely low-density lipoproteins before releasing them into the bloodstream. Given that cholesterol is hydrophobic and cannot be transported through the blood, it must be packaged with Apo protein. Triglycerides, cholesterol, and phospholipids are all found in very low-density lipoproteins. The membranes of cells, hormonal substances, bile acid, folic acid, and other substances are all made by the body using cholesterol. Although cholesterol travels to and from the tissues, it must bind to certain blood protein molecules. In addition to being a regulating molecule in and of itself, cholesterol is the building block of all steroidal hormonal substances and vitamin D counterparts.

2. Discussion

Cholesterol may be helpful as an antitumor modulator and is responsible for regulating development and growth throughout life. It serves several essential purposes within the cell. One of the chief sites wherein cholesterol gets utilized is in the cellular membrane. It adds to the membrane's fluidity and is necessary for its proper construction.[1] This fluidity may affect some tiny molecules'

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capacity to permeate the membrane, altering the cell's internal environment in the process.[2] Cholesterol also contributes to intracellular trafficking within the membrane. In addition to its role in the cell membrane, cholesterol serves several additional biological purposes. Cholesterol is the precursor of all types of steroid hormones, including glucocorticoids, mineralocorticoids, and sex hormones. The placenta and ovaries produce oestrogens and progestins, the testes produce testosterone, and the adrenal cortex produces cortisol, aldosterone, and androgens. The initial restricting event is the transformation of cholesterol to pregnenolone, which becomes oxidized and isomerized to progesterone. In the mitochondria and ER, it is further modified by a variety of hydroxylation reactions to other steroid hormones. Aldosterone predominantly impacts the tubules of the kidneys, encouraging the intake of water and salt and the expulsion of potassium. Eventually, it causes blood pressure to rise. Through its effects on intermediate metabolism—that is, enhanced gluconeogenesis and the inflammatory and immunological responses—cortisol enables the body to manage and react to stress. Sexual differentiation, desire, spermatogenesis, and the development of ovarian follicles are all regulated by the androgens, more especially by testosterone, oestrogens, and progestins.

According to Di Ciaula et. al.[3], bile salt, which facilitates digestion and encourages the absorption of fat-soluble vitamins, also contains cholesterol. Although cholesterol is essential for many basic cell processes, if it is left to accumulate dangerous blood levels, it may be harmful to the body. Blood cholesterol levels can be influenced by several variables, some of which are controlled and some of which are risk factors that are not. Smoking, inactivity, poor nutrition, being overweight or obese, and so on are examples of controllable variables; age and family history are examples of non-controllable ones. Overweight people frequently have elevated cholesterol as well. After menopause, women may have higher levels of low-density lipoprotein cholesterol. Moreover, the risk of high cholesterol is increased by other disorders. This is most prevalent among diabetics, although it can also be brought on by rheumatism, an underactive thyroid, and liver or renal illness. Additionally, taking some medications (such as HIV meds or steroids) might raise cholesterol levels to a certain degree.

Furthermore, some people have elevated cholesterol from birth because of their genetic composition. They call this kind of illness familial hypercholesterolemia. This occurs when an offspring inherits a gene mutation from their parents that prevents the correct processing of low-density lipoprotein cholesterol. Heterozygous familial hypercholesterolemia is a condition in which only one parent typically has the gene. The effect is stronger if the genetic problem (homozygous familial hypercholesterolemia) is passed on from both parents. However, this is quite uncommon. Because individuals with familial hypercholesterolemia have extremely high cholesterol levels, using the medicine that lowers cholesterol is the preferred course of therapy.

Despite the general public's high level of knowledge of the low-cholesterol diet and its health advantages, more recent research has revealed fresh data, necessitating more active participation from all healthcare teams. If an individual has no other risk factors, their total cholesterol levels should be less than 200 mg/dL. However, if they smoke or have cardiovascular risk factors like high blood pressure, diabetes, or pre-existing cardiovascular disease, less than 130 mg/dL level of L.D.L. cholesterol is ideal. Furthermore, it is deemed undesirable when H.D.L. cholesterol levels fall below the criteria of 40 mg/dl for males and 50 mg/dl for women. A straightforward blood test may be used by any doctor to determine a patient's cholesterol levels. The blood test determines the quantity of triglycerides, another kind of blood fat, the volume of H.D.L. and L.D.L. cholesterol, and the total cholesterol concentration. It's interesting to note that the risk for early atherosclerotic cardiovascular illnesses rises when L.D.L. cholesterol levels are too high, a condition known as hypercholesterolemia.[4] There is sufficient data to conclude that adult atherosclerotic disease is correlated with the accumulation of plaque in arteries, which starts in early infancy. Therefore, all children should be encouraged to maintain a healthy diet and lifestyle, irrespective of risk factors. Therefore, establishing good eating habits at a young age can eventually lower the risk of cardiovascular disease. Foods high in fruits, vegetables, whole grains, nuts, seeds, and fish should be promoted for all children two years of age and up. Limiting sugar-rich meals and beverages is necessary. Another rising health concern in today's lives linked to the use of foods rich in cholesterol is childhood obesity. If an adult's blood has too much cholesterol, part of it may get stuck in the artery walls, where it accumulates over time to create plaques. Atherosclerosis is the term for the narrowing and decreased flexibility of blood arteries caused by these plaques. Atherosclerosis of the carotid and vertebral arteries causes stroke symptoms, while atherosclerosis of the coronary circulation causes coronary artery disease. Stroke-related fatalities are the second greatest cause of mortality globally, after ischemic heart disease caused by coronary artery disease. Coronary artery disease, also known as CAD, is caused by atherosclerosis of the coronary circulation, while stroke symptoms are caused by atherosclerosis of the carotid and vertebral arteries. Stroke-related deaths are the second greatest cause of death globally, after ischemic heart disease caused by CAD. Together, these two diseases continued to be the world's leading causes of mortality for the past 15 years, contributing to 15.2 million fatalities in 2016.[5] Trans

fats cause inflammation, insulin resistance, endothelial dysfunction, arrhythmias, and negative effects on lipid and lipoprotein metabolism.

3. Conclusion

In modern medicine, adequate education and unambiguous signals on the current standards and recommendations are crucial due to the intricacy of cholesterol metabolism and its many impacts on the illness process. Over time, the patient's cholesterol levels can be lowered by maintaining a balanced diet and lifestyle. According to current dietary standards, polyunsaturated fatty acids should be consumed in place of saturated fats, which should not exceed 10% of daily caloric intake. A diet high in minimally processed fat and low in trans and saturated fat is the recommended quality of fat consumption. Nuts, avocados, seeds, seafood, and other foods high in healthy fats should be promoted.[6,7] It is important to remember that while establishing comprehensive dietary consumption objectives, the emphasis should not be on limiting overall fat intake, but rather on substituting monounsaturated and polyunsaturated fat for trans and saturated fat. Many items labelled as "low-cholesterol" may contain large amounts of trans or saturated fat, thus caution is advised. Increased consumption of bioactive foods, such as fruits, nuts, seeds, vegetables, legumes, whole-grain products, and plant oils, should also be prioritized because they are associated with a decreased risk of obesity, diabetes, and cardiovascular illnesses. The options include "added calcium" (at least 100 mg/100 mL) or low- or reduced-fat, flavourless milk, yoghurt, and other dairy products. Individuals with elevated cholesterol levels have to select lower-fat options. Reduced intake of processed meats is necessary since they contain a lot of trans fat, which raises blood cholesterol levels.[8] Any meat that is preserved by smoking, curing, salting, or the application of extra chemical preservatives is considered processed.[9] It is preferable to flavour food with herbs and spices rather than salt. Generally abundant throughout plant-based foods such as sunflower and canola seeds, oil from vegetable sources, and (in lesser amounts) nuts, legumes, cereals, fruit, vegetables, and vegetables, plant-derived sterols have been associated with lower cholesterol concentrations. Furthermore, altering our lifestyle choices may also aid in lowering our triglyceride and cholesterol levels. A person should limit the consumption of processed meats, as they contain a lot of trans fat, which raises your blood cholesterol levels. Any meat that is preserved by smoking, curing, salting, or the application of extra chemical preservatives is considered processed.[10,11]

Organizations including the American Heart Association, American College of Cardiology[12], European Society of Cardiology, and European Atherosclerosis Society[13] have issued guidelines that emphasize optimizing L.D.L. levels. Numerous clinical studies have shown that reducing L.D.L. levels dramatically lowers the rates of cardiovascular events and death. For the primary prevention of coronary artery disease, H.D.L. targeting is not advised by current consensus guidelines.[14] However, new research has indicated that serum cholesterol efflux capacity might be useful in predicting whether a patient would have coronary artery disease.[15] These few recommendations can include cutting back on or quitting alcohol use and avoiding binge drinking. Triglyceride levels may be successfully lowered as a result. Additionally, smoking should be avoided as it makes it easier for L.D.L. cholesterol to enter artery cells and harm them. Because it raises H.D.L. levels while lowering L.D.L. and triglyceride levels, regular exercise should be a part of everyday routine. Exercise additionally aids in the dropping of fat in the body. Controlling body weight is essential since being overweight can lead to elevated levels of L.D.L. and blood triglycerides.

It has been noted that while high blood cholesterol levels sometimes have a hereditary component, dietary and lifestyle modifications alone are frequently insufficient to reduce cholesterol. High cholesterol is caused by mutated genes that some individuals inherit, and diet and lifestyle changes typically aren't enough to reverse this. A doctor may suggest drugs to lower blood L.D.L. cholesterol levels if a patient at risk for coronary heart disease does not see a decrease in their L.D.L. cholesterol level after implementing dietary and lifestyle modifications. The most frequently prescribed medications for reducing cholesterol levels in the blood are statins. The most frequently prescribed medications for reducing cholesterol levels in the blood are statins. These minimize the cholesterol levels generated by the liver. On the contrary, the liver relies on cholesterol which exists in the bloodstream. As a result, the patient's blood L.D.L. cholesterol level drops. A person may require additional medications as directed by their doctor even if statins are insufficient in lowering their cholesterol levels. However, even if a person is taking medicine, food and exercise will always be crucial. If necessary, a physician may also recommend a patient to a cardiologist.

If a person has diabetes, he ought to strive towards maintaining blood glucose levels within the range that is recommended since high blood sugar is associated with a higher risk of atherosclerosis, heart attacks, and strokes. Patients must be carefully instructed on how to lower their blood cholesterol levels and the negative consequences of excessive cholesterol. Changes in the patient's lifestyle, such as quitting smoking, exercising, and changing their diet (reducing saturated and trans fats while increasing fiber and total calories if they are obese and taking plant-based supplements), are frequently effective ways to lower cholesterol. Individuals who have already experienced a heart attack, stroke, or other cardiovascular condition are at a heightened risk of acquiring more heart issues. Therefore, statins are advised for both them and those

with familial hypercholesterolemia. Dietary supplements containing omega-3 or omega-6 fatty acids have not been shown to offer cardiovascular disease prevention. However, there is proof that omega-3 fatty acid-containing fish oil capsules may raise the risk of an irregular heartbeat. Some specialists now advise against taking them as a result. In summary, cholesterol is a metabolically important substance that regulates a number of critical aspects of human health. Like all things, there are drawbacks to excessive intake. However, if consumed in moderation and according to a healthy regimen, cholesterol plays a vital role in controlling cell activity in addition to its structural function of supplying stability and fluidity.

4. Source of Funding

None.

5. Conflict of Interest

None.

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