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Research Article

A Review of Cholesterol's Dual Impact: Human Health and Environmental Consequences

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Abstract

Indiscriminate consumption of fatty foods especially those with higher percentages of saturated fatty acids in and around the world is likely to be in excesses in a few years to come. This is particularly so owing to man's detrimental eating habits as it portends potential risk for coronary heart diseases among unsuspecting consumers. Although man has the enzymatic capacity to convert excess fatty acids to harmless substrates within the body system, however there is serious pressure on such functions when they are more than normal daily body requirement. The impact of heavily rich fat meals on the large supply of total fats and its saturated fatty acids derivatives in the human system has been largely traced to dietary intake of lipid-rich diets. The consequential effect of such diets over time could damage arteries, contribute to heart disease, and even stroke. Incidentally, this has been narrowed to cholesterol (lipoprotein), a waxy substance that the body requires to perform certain critical functions including digestion, circulation, growth and even the nervous system regulation. There are two distinct known forms of lipoproteins: High-density and Low-density lipoproteins. Even though both are essential, the excessive intake of low-density lipoprotein (LDL) is dangerous and could trigger certain cardiovascular diseases and even death due to its excessive accumulation in the body. Despite these foregoing however, they play very critical roles in the lives of virtually all living organisms including man. Therefore it harps on the study for a comprehensive review of the concept and dispels the misinformation about the significance and implication of the effects of both saturated and unsaturated fatty acids as probable precursors for certain cardiovascular ailments. Little wonder that some conscious individuals are cautious in choosing their meals owing to this trepidation. It therefore becomes imperative to undertake a review on related works to giving suitable medical information to arm individuals with reliable data towards the trend.

Keywords: *Cardiovascular diseases, diet, fat food, heart attack.*

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Introduction

Cholesterol is a waxy substance made in animals' liver and also supplied in diet through animal products such as meats, poultry, fish and dairy products. It is however, needed in the body to insulate the nerves, and in the making of cell membranes and the production of certain hormones, and it is also an important lipid in some membranes. However, the body produces enough

cholesterol; therefore including even minutes of dietary cholesterol in human diet is less necessary, (Ma, 2004).

Food is categorized into six, out of which three are essentially larger molecules and they are carbohydrates, protein and fat and oil (also referred to as lipids). Carbohydrates are the energy supplying food. They are largely obtained

from cereals (maize, rice, millet, sorghum and wheat) and tubers (potato, yam and cassava). These are the conventional ones. Others such as toffee, beets and syrups are non-conventional carbohydrates and only recently discovered. They are vital as energy suppliers for metabolic activities. Glucose, the final product is the main fuel. It helps in the supply of energy needed for metabolic activities including the movement of digested food molecules, the flow of blood and the activities of brain. Others are heart-beats, the secretion of hormones to mention a few. Proteins on the other hand are meat, egg, milk and beans. They are required for growth, tissue development; repair of damaged cells and help in the fight against diseases. Proteins come from two main sources, plants and animal sources. Protein's final products are amino acids. Fat and oil are obtained from lard, tallow, pulses, butter and so on (Ansell *et al.*, 1973). Other diets containing lipids are butter, cheese and vegetable oils. The final products are fatty acids and glycerol which form the basis for the work. The term lipid denotes diverse kinds of compounds which are insoluble in water but with rare solubility in non-polar solvents. They also give energy, even more than that of carbohydrates, (Berger, *et al.*, 2019). They also encourage satiety; improve flavor, and palatability of the diet. Their functions include storing energy and building structural components of cell membrane. For the purpose of this review however, our concern will essentially be on the triglycerides and cholesterol which are relatively simpler units of lipids. Other such as triacylglycerol is equally important but also one of the derivatives. They are only different in terms of number of carbon molecules, number of fatty acids chain, number and position of the hydroxyl and carbonyl groups. They are products of lipolysis, an interesting phenomenon which is the process of breaking down of fats into simpler units. This is very significant as it underscores the importance of fatty acids and glycerol in human nutrition, and so also is the lipogenesis, the opposite. .

Cholesterol however, plays a major role in human heart health. It can be both good and bad. High-density lipoprotein (HDL) is good cholesterol and low-density lipoprotein (LDL) is bad. High cholesterol in serum is a leading risk factor for

human cardiovascular diseases such as coronary heart disease and stroke (Tabas, 2002, Ma, 2004)

Cholesterol

Cholesterol is a major constituent in almost all membranes in eukaryotes but, absent in intracellular membranes as well as in most prokaryotes (Ma, 2004, Sekhar *et al.*, 2020, Ray *et al.*, 2016). The animal plasma membranes of eukaryotic cells are usually rich in cholesterol, whereas the membranes of their organelles typically have lesser amounts of this neutral lipid (Ma, 2004). Cholesterol is a bulky steroid structure which has four rings of hydrocarbon that are fused. The oxygen atom in its 3-OH group comes from O₂ (Ma, 2004) (Figure 1). A hydrocarbon tail was connected to one end while a hydroxyl group was collected to the other end of the steroidal structure. The hydroxyl group can easily form hydrogen bonds with adjacent sphingolipid head groups and also the carbonyl oxygen of phospholipid (Sekhar *et al.*, 2020, Ray *et al.*, 2016). The animal plasma membranes of eukaryotic cells are usually rich in cholesterol, whereas the membranes of their organelles typically have lesser amounts of this neutral lipid (Ma, 2004).

The amphipathic nature of cholesterol molecule is so since it comprises of hydrophilic and hydrophobic portions. Its hydroxyl group is arranged with the phospholipid's phosphate head on the cell membrane, while the remaining part of the cholesterol is linked with the membrane's fatty acid (Sekhar *et al.*, 2020, Ray *et al.*, 2016). It was earlier stated that cholesterol is present in all the cell membranes; it preserves the integrity of the cell and prevents the cell from over-fluidity. It has a crucial role in regulating the fluidity of the cell membrane in mammals and incorporates itself into bilayers vertical to the plane of the membrane. It also contributes to increase permeability of the cell membrane for certain ions such as hydrogen and sodium (Sekhar *et al.*, 2020, Ray *et al.*, 2016).

Cholesterol is a waxy substance also called lipoprotein and is usually produced by the liver. They function in the production of hormones; the building of cells and the synthesis of certain very vital vitamins, Kumar *et al.*, (2022). Usually the

body cannot synthesize each level of cholesterol it requires and little wonder that minute dietary cholesterol is recommended in the human diet Ference *et al.*, (2020). Cholesterols are high-molecular-weight alcohols with a characteristic cyclic nucleus and are not unrelated to the structure of fats or phospholipids, but their occurrence in foods and body tissues esterified to one fatty acid per molecule is interesting, Grundy, *et al.*, (2019) For example, its emphasis as one of the components of membranes in body cells and so also its requirement underscore its fundamental importance in brain and nervous tissue development. Furthermore, it is an important substrate for bile acids, steroid hormones and other derivatives like 7-dehydrocholesterol in the skin, which in turn is the precursor for vitamin D synthesis. Cholesterol occurs naturally only in foods of animal origin. The highest concentrations are found in liver and egg yolk, while red meats, poultry (especially the skin), whole milk, and cheese also contain significant contributions to the diet. Like triglycerides, there are ranges of cholesterol from normal to middle and high levels. A range below or equal to 199 mg/dL is normal or termed good, 200 to 239 mg/dL medium level while a value above 240 mg/dL is high and could be terrible, (Appel, 2005).

Hyperlipidemia

Hyperlipidemia is an elevation of lipids (fats) in the bloodstream. These lipids include triglycerides, phospholipids, cholesterol and cholesterol esters (compounds), as they are transported in the blood as part of large molecules called lipoproteins. Blood (plasma) lipoproteins have five major families which include (1) high-density lipoproteins (HDL), (2) low-density lipoproteins (LDL), (3) intermediate-density lipoproteins (IDL), (4) very low-density lipoproteins (VLDL), (5) chylomicrons. Hyperlipidemia is defined in terms of the type classes of elevated plasma lipoproteins. Hypercholesterolemia is the term for high cholesterol levels in the blood. Hypertriglyceridemia refers to high triglyceride levels in the blood. The average (Ma, 2004).

Effect of Dietary Fat

The relationship between the consumption of dietary fat and disease risks continues to exist

generating an expected controversy after so many years of research. Some researchers agreed while some did not agree with the hypothesis that the associations of dietary fat with cardiovascular disease, obesity, and specific types of cancers have left a series of repetitive expensive studies that could not bring significant conclusions (Pervin *et al.*, 2020).

Dietary fats, mainly the triglycerides from both animal and plant derived foods, are traditionally considered unhealthy components, Research over the past few decades has recognized that different types of fats have divergent effects on cardiovascular health (Pervin *et al.*, 2020, Ascherio, 2002). The outcomes of large prospective epidemiologic studies uphold the theory that the risk of coronary disease is dependent on the quality of dietary fat rather than its quantity (Ascherio, 2002). From the nutritional point of view, the epidemiology of cardiovascular diseases has mainly concentrated on the type of dietary fat (such as polyunsaturated, monounsaturated, and saturated), lipoprotein metabolism, blood cholesterol, and coronary artery disease risks (Pervin *et al.*, 2020). However, cholesterol and saturated fat seem to raise the risk of coronary heart disease (CHD) as predicted by their effects on blood lipids, strong evidence has shown that the deleterious effects of trans unsaturated fatty acids (trans fatty acids) extend beyond those predicted by their well-known adverse influence on the ratio of low-density lipoprotein to high-density lipoprotein cholesterol (Ascherio, 2002, Pervin *et al.*, 2020). High levels of cholesterol concentration in the blood may cause predisposition to risk of a heart attack in individual especially when it builds up along the wall of arteries. This could lead to a condition called atherosclerosis which is due to the formation of plaques that inhibits the blood flow, Ference *et al.*, (2018). A bad scenario may occur if both high triglycerides and disproportional levels of cholesterol occur at the same time. This is a critically dangerous situation of heart attack or stroke (Gao and Mao, 2016.)

Reasons for increased risks of high cholesterol

Increased risks for high cholesterol is owing to the Cholesterol can be good or bad. HDL is called “good cholesterol” that is good for the

cardiovascular system and LDL is called “bad cholesterol” that is bad for the cardiovascular system. These are the form in which cholesterol travels in the blood. LDLs have little protein and high levels of cholesterol and HDL has a lot of protein and very little cholesterol. LDL is the main source of artery clogging plaque. HDL actually works to clear cholesterol from the blood (Ma, 2004). The standard test of cholesterol is done after a 9-12 hours fast without food, liquids or pills. It gives information about total cholesterol, LDL, HDL and triglycerides (blood fats). The cholesterol content in blood is the key data for the health information of cholesterol related (Table 1). For example, a person’s total cholesterol is 200 mg/dl or more, and the HDL cholesterol is less than 40 mg/dl, then the person needs to have a lipoprotein profile done to determine LDL cholesterol and triglyceride levels. A person’s LDL cholesterol goal depends on how many other risk factors the person has: (1) If there is no coronary heart disease or diabetes or any other risk factors, his/her LDL goal is less than 160 mg/dl. (2) If there is no coronary heart disease or diabetes and have two or more risk factors, the LDL goal is less than 130 mg/dl. (3) If there is coronary heart disease or diabetes, his/her LDL goal is less than 100 mg/dl (Ma, 2004). The family history, poor health management and chronic kidney problems could trigger dangerous trends in the lives of victims (Godsland *et al.*, 1992). However, medication with potent selective cholesterol absorption inhibitors may be prescribed by seasoned medical personnel.

Lowering cholesterol levels

Cholesterol and saturated fat seem to raise the risk of coronary heart disease (CHD), however, increased consumption of the polyunsaturated fats, linoleic acid and linolenic acid, appears to reduce the risk of CHD (Ascherio, 2002, Pervin *et al.*, 2020). Reducing the risk associated with high cholesterol levels is very vital. Habits such as diet control and lifestyle adjustment are crucial. Good eating habits, regular exercise and total abstinence from smoking are greatly recommended, (Erlinger, (2005). Others are maintaining moderate weight, regular exercises and limiting much of consumption of poor fatty diet like trans-fats (Erlinger, (2005), Ference *et al.*, (2018)).

Increase risks of high cholesterol

The family history, poor health management and chronic kidney problems could trigger dangerous trends in the lives of victims (Godsland *et al.*, 1992). However medication with potent selective cholesterol absorption inhibitors may be prescribed by seasoned medical personnel, (Spady *et al.*, 1993)

Atherosclerosis and Cardiovascular Disease

The thickening of the wall of the artery due to the accumulation of minute cholesterol droplets were fingered as far back as the 17th century by Rokitsansky, (1849) and his team as potentially dangerous to good healthy living. Other workers were Virchow and Anitschkow, (1913) respectively made different submissions on the subject matter but not further substantiated at the time this could probably be because of the limitation of the study. However, moving forward, the lesions were named arteriosclerosis in 1829, and the distinctive form associated with lipid deposition was thereafter referred to as atherosclerosis in 1904 (Ross 1999, Libby 2002). However, atherosclerosis was not considered a common and serious cause of death until decades after when coronary atherosclerosis was linked to thrombosis and myocardial infarction. Coronary heart disease (CHD) reached epidemic proportions in the United States before dietary fats were seriously suspected of being causative agents around 1950, (Erlinger, 2005, Appel, 2005, Ference *et al.*, 2018). The first recorded evidence that diet had any association with atherosclerosis was the observation by team of researchers in the work of Gao, *et al.*, (2000) who fed rabbits with fat rich-diets and were found to develop arterial lesions similar to atherosclerosis in humans. Gould, (1966) and others like Libby in (2002) identified cholesterol as the dietary component responsible for hypercholesterolemia and atherosclerosis in rabbits, (Anitschkow, (1913) Bryne, 2023). In subsequent years however, investigators demonstrated that many animal species were susceptible to dietary intake of cholesterol, but this phenomenon was viewed as an academic adventure which were later substantiated especially as it relates to human

health. This became prominent in the Western world during the first half of the twentieth century. A Holland physician working in Java reported in the year 1916 that native Indonesians had lower levels of plasma cholesterol than their colonists from the Netherlands and associated this observation with a much lower frequency of CHD in the indigenes, (Anitschkow, 1913, Ross 1999). He also observed further that junior Japanese staff on Dutch passenger ships that ate typical Dutch delicacies had high plasma cholesterol levels and precocious CHD related ailments. These observations published in an obscure Journal but were not substantiated until about 40 years later (Anitschkow, 1913). In 1934, some medical team that the distribution of atherosclerotic diseases in many parts of the world likened to the consumption of excess fats and cholesterol, (Anitschkow, 1913) and Kummerow, (1957). Nevertheless, appreciation of the relationship of diet to serum cholesterol levels, and also to CHD, develops more slowly. Although there had been an accumulation of epidemiologic evidence supporting the concept that diet, especially dietary fat, was associated with elevated serum cholesterol concentrations and with CHD (Appel, 2005), there also was some level of doubt as indicated by the comments from previous workers but this could not substantially invalidate these earlier submissions, (Kummerow, 1957). Furthermore, early developments of these concepts, along with the controversies, probably gave less recognition to the major findings, (Ugwaja, *et al.*, 2013.)

Circulatory and cardiovascular systems

The concept of atherosclerosis is believed to be a result of excessive consumption of bad lipoprotein (LDL) also called bad cholesterol in the body as it builds up the threatening plaques in the arteries, leading to the formation of clogs and making them less flexible (Mozaffarian 2010, Ross 1999). It hardens arteries and inhibits blood flow which specialists described as potentially susceptible to heart ailments including heart attack and even stroke, Wang (2016).

The Endocrinology

The system of the body saddled with the responsibility of hormonal production is the Endocrine system. These hormones are

multifaceted and they include but not limited to the following insulin, oestrogen, adrenalin, testosterone and cortisol. Research has revealed that the levels of oestrogen levels increase during a woman's monthly flows. This is particularly so for the bad cholesterol also known as Low-density lipoprotein and also the High-density Lipoprotein, the good cholesterol, (Appel, 2005 and Ference *et al.*, 2018). This may be one reason why females are more at risk than men especially at post-menopausal period. The opposite is the case for male. Androgen deprivation therapy reduces levels of male hormones to stop prostate cancer growth and also the LDL cholesterol levels. A deficiency of growth hormone can therefore increase LDL cholesterol levels.

Nervous system

As reiterated above, the cholesterol is an important constituent of the human brain. The brain has 25% of the entire body's supply of cholesterol. It is a good precursor for the development and protection of nerve cells. It also facilitates communication between the brain and the rest of the body. Even though, some levels of cholesterol are required for the brain to function optimally, the excess is bad and damaging. These could or may result in strokes and a critical disruption in blood flow to the brain, leading to loss of memory, impaired movement, difficulty in swallowing and speech and other functions, Wang (2016). Therefore high blood cholesterol especially LDL type is damaging and detrimental. Unfortunately reversing the situation then may not be as easy, therefore regulation and observing medical instructions are fundamentals for both sexes, (Mozaffarian 2010).

Digestion

The relevance of cholesterol in the entire process of food digestion cannot be over emphasised. Besides helping to facilitate the breaking down foods and ease the absorption of the nutrients therein, also significantly impact on the reproductive process of entire organisms including man (Cross 1998, Wang (2016) and Miller and Strauss 1999). It is also central to the critical and timely supply of glucose occasioned by the instruction to the pituitary hormone at the base part of the brain to direct it to the site of need for the production of glucose which in turn signals

the insulin hormone that guides the control of glucose. So also when glucose is more than the requirements, glucagon hormone is called upon to address the situation. On the other hand, if the cholesterol levels are either too much due to excessive dietary intake or also the inherent body production, there occur many physiological activities for the bile. This unfortunately may lead to the formation of gallstones. The excess forms crystals and then hardens becoming stones like in the gallbladder. Gallstones are painful. Therefore it is essentially crucial to monitoring the levels of cholesterol levels and ensures lowering its associated risks for heart disease for a good living, (Ugwuja, *et al.*, 2013 Miller and Strauss 1999, Libby, 2002).

Effects of triglycerides

This review may be inconclusive if it remains silent on the activities of triglycerides. Although there are reports under estimating the critical influence of triglycerides as less compared with cholesterol, human health systems firmly require each of them in the right amounts. Triglycerides are another fat in the bloodstream. High levels of triglycerides are also linked to heart disease. Triglyceride is the most common type of fat in the body. Many people who have heart disease or diabetes have high triglyceride levels. Normal triglyceride levels vary by age and sex. A high triglyceride level combined with low HDL cholesterol or high LDL cholesterol seems to speed up atherosclerosis, which is the build-up of fatty deposits in artery walls that increase the risk for heart attack and stroke (Ma, 2004). The triglycerides are fats in the blood used as energy sources, mostly found in the blood stream and because they are not water-soluble, their elimination from the body is difficult. For healthy human status, there are ranges relative to their proportions in the blood levels, (Spady *et al.*, (1993). This however is usually run by broad test on the blood triglycerides levels. They may range from normal, border limit and also the extreme. The recommended level for the normal is close to or less than 150mg/dl while 151 to 199 mg/dl is termed the border or medium limit. Other levels within and above 200-499 mg/dl threshold are extreme and could be a potential recipe for triggers, (table 1) Appel, 2005).

Parameters determining triglycerides levels.

Rimm *et al.*, (1999), Miller and Strauss (1999) and Libby, (2002) at one time or the other identified family history as one of the factors influencing triglycerides proportions in man blood levels but played down its negative effect as potential danger. Other factors such as diets, diseases and alcohol consumption have been identified as possible factors that can predispose humans to present with symptoms that lead to potentially susceptible to Coronary Heart related Diseases. Although moderate consumption has long time been advocated, however there are reports associating one to two drinks with increased High-density lipoprotein cholesterol levels, (Rimm *et al.*, 1999). Similarly there are pronounced caution on heavy alcohol consumption as continuous and indiscriminate consumption of as a precursor for serious cardiovascular diseases. Rehm *et al.*, (2017). Reports implicating certain selected medication including supplements are also possible trigger. Examples of such may include Thiazide diuretics, corticosteroids and Beta blockers. On the other hand, obesity at younger ages; body mass index and unnecessarily high waist circumference are possible.

Consequences of high triglycerides

The unusually high levels of triglycerides require urgent medical care as it may be serious if not corrected immediately. Besides predisposing victims to some specific underlying health ailments, it may portend very dangerous health implications to reverse if not remedied early, (Miller and Strauss, 1999, Bayram, 2014). Dyslipidemia, another lipid induced metabolic disorder that may lead to a continuous increase in the plasmatic concentration of cholesterol and triglyceride. Berglund *et al.*, (2012) has earlier reported high triglycerides levels above 1000mg/dL as potential risk of pancreatitis. These findings were also corroborated in the submission of other worker including Yandav and his colleagues, (Yadav *et al.*, 2012). Moreover, obesity is one of the resulting ailments believed to restrict the activity of lipolysis through insulin resistance, finally giving rise to the failure of its

removal from the body. This may thereafter become a pivot for continuous increase in the plasmatic concentration of both cholesterol and triglyceride, Ni, (2015). It is therefore the belief of most earlier researchers that high triglycerides could be a major cause of higher morbidity in virtually all developing countries (Appel, 2005) and has extremely worrisome health implication for inhabitants of such countries (Gao, 2016 and Ma, 2016). The process eventually degenerated into a condition known as Hypertriglyceridemia, Ni, 2015) a critical health challenge that could be extremely difficult to reverse especially once the hormonal function has been impaired. Unfortunately, hypertriglyceridemia is asymptomatic until the triglyceride levels exceed 2000 mg/dl when the victim becomes critically ill. This is one of the reasons behind the concern occasioned by high levels of intake of the dietary fats. So ignoring their possible effects may degenerate into serious heart diseases, a situation which may snowball into heart, high blood pressure, stroke or diabetes depending on the type of complications the victim comes down with. Even though some presentations like impaired walking, problem in swallowing, difficulty in articulating words and others are common, some individuals may be asymptomatic. Other likely signs are fatigue, pancreas inflammation and or stroke, (Rimm *et al.*, 1999). It becomes important to note that complications of coronary heart diseases could be due to atherosclerosis, inflammation of the pancreas and even stroke. It should be noted here that the recurrence of chronic conditions may cause the victims to come down with kidney diseases and thyroid conditions, (Gao *et al.*, 2020, Ross 1999)

Environmental Effects of Cholesterol Distribution in Man

Cholesterol is a vital lipid molecule in the human body, playing a crucial role in cell membrane structure, hormone production, and fat digestion (Brewer, 2014). However, its distribution in the body has significant environmental implications, affecting not only human health but also the ecosystem. One of the primary environmental effects of cholesterol distribution is its impact on cardiovascular health. Elevated cholesterol levels can lead to atherosclerosis, increasing the risk of

heart attacks and strokes (WHO, 2017). This, in turn, affects the environment by; increasing healthcare costs and resource utilization (Kamal-Bahl *et al.*, 2007), enhancing greenhouse gas emissions from healthcare facilities (EPA, 2019), promoting unsustainable agricultural practices to produce cholesterol-lowering food products (Tilman & Clark, 2014). Furthermore, cholesterol distribution affects the environment through water pollution: Cholesterol-containing waste from pharmaceutical and agricultural industries contaminates water bodies, harming aquatic life (EPA, 2019). Soil degradation: Cholesterol-rich animal waste and agricultural by-products contribute to soil pollution, reducing fertility and affecting ecosystems (Tilman & Clark, 2014). Climate change: The production and transportation of cholesterol-lowering products contribute to greenhouse gas emissions, exacerbating climate change (EPA, 2019). Thus, the environmental effects of cholesterol distribution in humans are multifaceted and far-reaching. Understanding these impacts is crucial for promoting sustainable healthcare practices, reducing environmental pollution, and mitigating climate change.

Conclusion

The risk associated with cholesterol consumption though was found to be dangerous especially among individuals but the essential wide broad precautions are highlighted under the recommendations however this doesn't mean the probable consequences could be ignored. While male stands on a bit saver side to a certain degree, female should be much more concerned when their cholesterol levels are more than the recommended threshold. Again the risks of elevated levels usually increase with age in females. Therefore both middle-aged men and elderly females should pay more attention to both blood cholesterol and triglyceride levels.

Some of the suggestions are possible precautions against chronic or deadly situations owing to indiscriminate intake of fat-rich diets most especially trans fats, increased consumption of the polyunsaturated fats, linoleic acid and linolenic acid. They include calculated and better eating habits, maintenance of moderate weight and reduction of highly saturated or trans-fats diets,

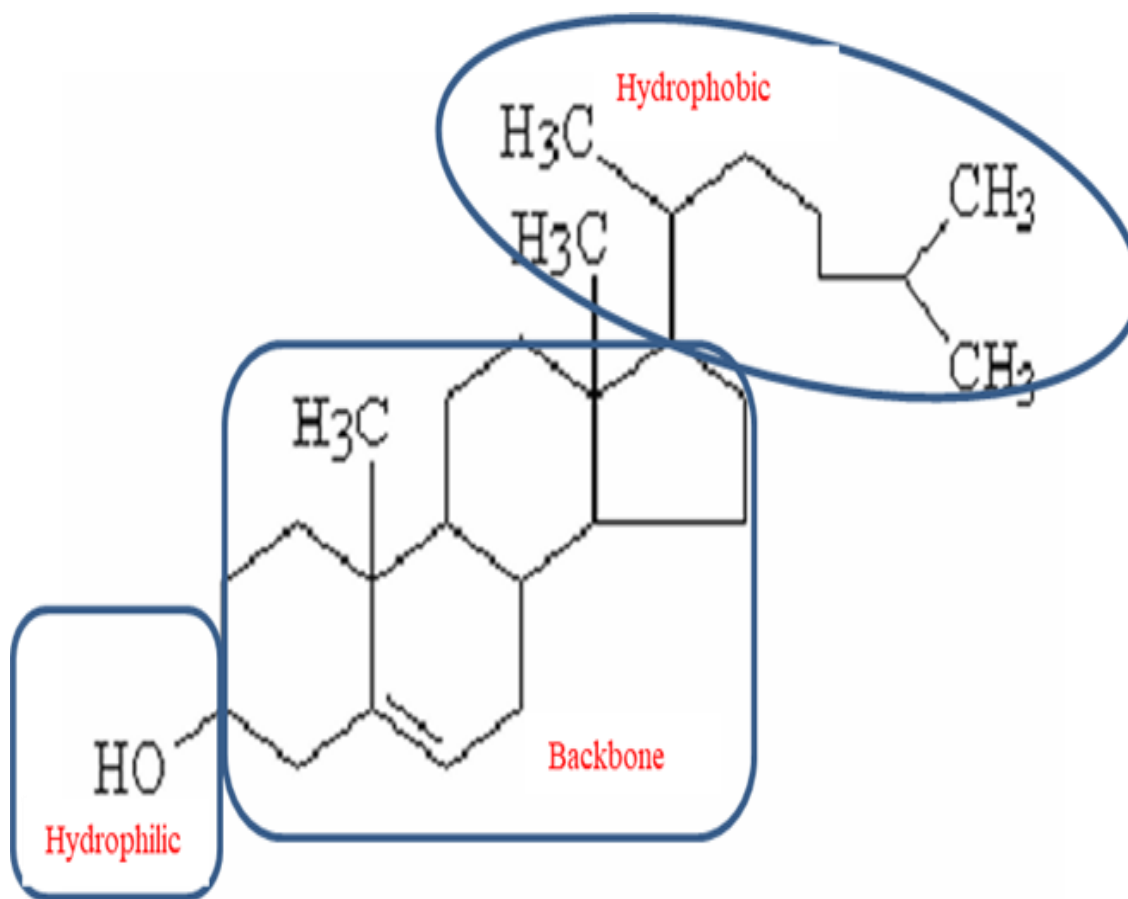
(Chen *et al.*, 2018 Wang *et al.*, 2014). Others such as outright abandonment of alcohol consumption, smoking and limiting carbohydrates and sugars could also be a way to go. Similarly, a brisk walk of 30-minute daily, timely and regular exercise and observing prescriptions that are recommended by medical personnel. Salt intake reduction, checking the blood pressure and undergoing cholesterol and sugar tests are very important.

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Cholesterol
Figure 1 Structure of Cholesterol

Table 1 Classification of Cholesterol

Cholesterol	Cholesterol level	Category
Total Cholesterol	Less than 200 mg/dl	Desirable level.
	200 to 239 mg/dl	Borderline high for heart disease.
	240 mg/dl and above..	High blood cholesterol. A person with this level has more than twice the risk of heart disease as someone whose

		cholesterol is below 200 mg/dl
HDL Cholesterol	Less than 40 mg/dl	Low HDL cholesterol. A major risk factor for heart disease
	40 to 59 mg/dl.	The higher HDL level, the better
	60 mg/dl and above	High HDL cholesterol. An HDL of 60 mg/dl and above is considered protective against heart disease.
LDL Cholesterol	Less than 100 mg/dl	Optimal
	100 to 129 mg/dl	Near or above optimal
	130 to 159 mg/dl	Borderline
	160 to 189 mg/dl	High
	High 190 mg/dl and above	Very high
Triglyceride	Less than 150 mg/dl	Normal
	150-199 mg/dl	Borderline High
	200-499 mg/dl	High
	500 mg/dl and above	Very high

(Ma, 2004)