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Review Article

Pharmacy practice for good health promotion

Dietary Fats Are Vital For Human Long-Term Health

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Abstract: Lipids are the major contributors of taste, texture and energy of a diet. Changes in the intake of dietary fats bring about varied serum cholesterol levels as well the other factors that cause risk of chronic diseases. It has been established over years that the risk of CAD and other chronic health problems are not significantly influenced by the dietary saturated fatty acids (SFAs). Many recent researches also reported that the SFAs present in dairy products and coconut oil are very helpful in improving the health of an individual. Even though enhancement of inflammation and augmentation of the chronic ailments by V6 polyunsaturated fatty acids (PUFAs) have been reported widely, the V3 PUFA's take the other side and act to counter the ill effects. Obesity and other associated health issues arise mainly due to the use of diets rich in carbohydrates instead of saturated fats. The benefits of replacing these carbohydrates and others with alternative nutrients have been well established with known mechanisms which bring down the adverse effects. The quality of fat may bring about chronic degenerative effects in the later stages. The use of fat and its types is shifted towards a pattern of healthy diet wherein the food may include a variety of different fats even at high levels. The present scenario of the researches in public health is mainly centered with the analysis of the association between dietary fat, level and quality, its impact on the risk of chronic diseases and cure. Thus, this review focuses on the need to re-examine the use of dietary fats and their clinical implications.

Keywords: *Dietary Fats, Lipids, Cholesterol,* Triglyceride, Body Weight

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1. INTRODUCTION

Fat is an essential component to carry out some bodily functions as well as critical building block of the body and brain. Fat is an important nutrient that the body needs for its basic functions. Eating foods with fat is definitely part of a healthy diet. It is essential for blood clotting, muscle movement and inflammation. Healthy fats are that which provide good energy, supports cell growth, and keeps cholesterol and blood pressure under control. Cholesterol is a main part of fats and produce important steroid hormones such as cortisol, estrogen, and testosterone. Fats are one of the three main macronutrient groups in human diet, along with carbohydrates and proteins and the main components of common food products like milk, butter, meat, egg, cooking oils etc. They are major and dense source of energy for many animals and play an important structural and metabolic functions in most living beings, including energy storage, waterproofing and thermal insulation. The human body can produce fat that it necessary for its routine, except for a few essential fatty acids that must be included in the diet. Fat usually means, any ester of fatty acids (or) a mixture of such compounds. The term often refers specifically to triglycerides which are the main components of vegetable oils or fatty tissue in animals. Any fat converted into energy, unused by our body is converted into body fat likewise; unused carbohydrates and proteins are also converted into body fat. All fats have a similar chemical structure: a chain of carbon atoms bonded to hydrogen atoms. The length and shape of the carbon chain and the number of hydrogen atoms connected to the carbon atoms makes one fat different from another. Seemingly slight differences in structure translate into crucial differences in the form and function. There are two main types of fatty acids, saturated and unsaturated. Fats are called saturated or unsaturated depending on how much of each type of fatty acid they contain. Saturated fats are solid at room temperature while unsaturated fats are liquid. Unsaturated fats are considered the healthiest type of dietary fat.[1,2] Fats are mainly composed of carbon, hydrogen, oxygen, some other elements such as nitrogen and phosphorus. They are non-polar or hydrophobic without any partially charged regions in the molecule.[3,4] Dietary fat refers to the fats and oils found naturally in animals and plants foods, which provide energy and the essential fatty acids (FA) necessary for growth and development. The energy content of a diet is contributed by the lipid content which also is related with its taste and texture. In addition to the absorption of fat-soluble vitamins and other food components, many important roles are taken up by the lipids in the body which include structural and functional component of all cell membranes, precursor for eicosanoids and cell signaling molecules. Intracellular trafficking proteins help in the transport of the lipids absorbed from plasma membrane. In the endoplasmic reticulum, these lipids are reassembled as chylomicrons, some amount of VLDLs and secreted from enterocytes. Metabolism and repacking of the fats into lipoproteins takes place in the liver. Lipids available in the chylomicrons and lipoproteins are removed by the adipose tissue which are hydrolyzed into lipoprotein lipase and utilized for energy storage. The fats are digested and absorbed well in the large intestine when there is no intestinal or pancreatic diseases, while the fats that do not reach large intestine would be metabolized by the microbiome.[5]

1.1 Main types of fat

There are 4 main types of Fat

1. Triglycerides
2. Phospholipids
3. Steroids
4. Prostaglandins

1.2 Triglycerides

Triglycerides are the fats obtained from food and carried in to the blood in higher amounts. Excess calories, alcohol (or) sugar, beverages, carbohydrates, in the body turn into triglycerides and are stored in fat cells throughout the body. Triglycerides and phospholipids are the main part of human cells. It helps the body absorb some important fat-soluble vitamins like A, D, E and K for daily requirements. These are composed of 2 building blocks. Some carbon atoms are linked by single bonds and others by double bonds. These bonds determine the type of fatty acid.[6]

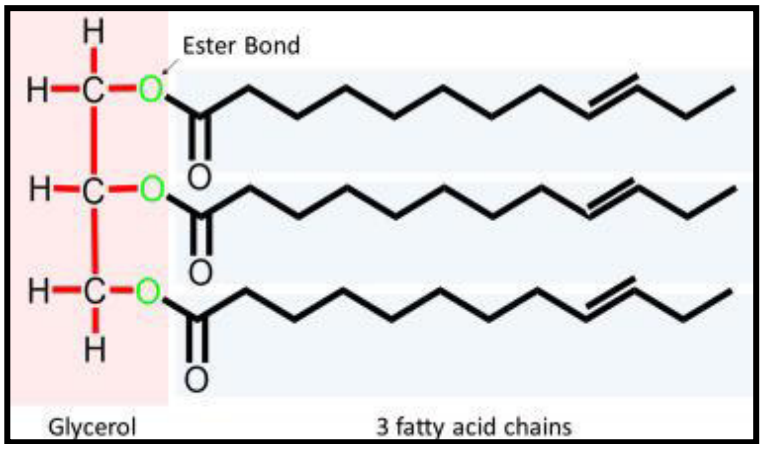

Fig. 1 Triglyceride[6]

Triglycerides are mainly classified into two types saturated fatty acids and unsaturated fatty acids which are further divided into mono, poly and trans unsaturated fatty acids. The 3 molecules of the triglycerides may contain either similar or different types of fatty acids. Triglycerides are found in many food items such as, vegetable oils (coconut oil, sesame oil, groundnut oil, sunflower oil, olive oil), meats, eggs, dairy products (cheese, ghee, whole milk) fast foods and deep fried foods. All types of baked foods and beverages like fruit drinks, soft drinks and alcohol also contain considerable proportion of triglycerides. Some dry fruits and seeds are rich sources of triglycerides. Saturated fats generally have a higher melting point than the unsaturated ones having same molecular weight. Saturated fats are solids while unsaturated fats liquify at room temperature. Unsaturated fats are prone to oxidation by air, which causes them to become rancid and inedible. The bonds in unsaturated fats can be converted into single bonds by reaction with hydrogen by a catalyst process called hydrogenation which turns vegetable oils into solid or semisolid vegetable fats like margarine.[7[

1.3 Phospholipids

Phospholipids are composed of a phosphate group, two alcohols and one or two fatty acids. One end of the molecule contains the phosphate group and one alcohol, with an electric charge and is hydrophilic in nature. The other end having fatty acids is hydrophobic in nature. Phospholipids are important in cell membranes forming a two-layer structure called the lipid bilayer, with the polar head facing out on each surface to interact with water, and with the 'tails' driven inward and pointing toward one another. The lipid bilayer is the structural basis of all cell membranes and is nearly impermeable to ions and most polar molecules. Phospholipids are the main component of cell membranes and similar in structure to triglycerides as they have 4 subs units. The head position of phospholipids molecule is water soluble and have hydrophilic polar head. The fatty acid end is non-polar and hydrophobic. These water fearing tails allow this molecule to join or bridge a water environment and a lipid environment. So, in water, these molecules will form bilayers with the fatty acid tacks facing each other, and heads facing outwards. [8]

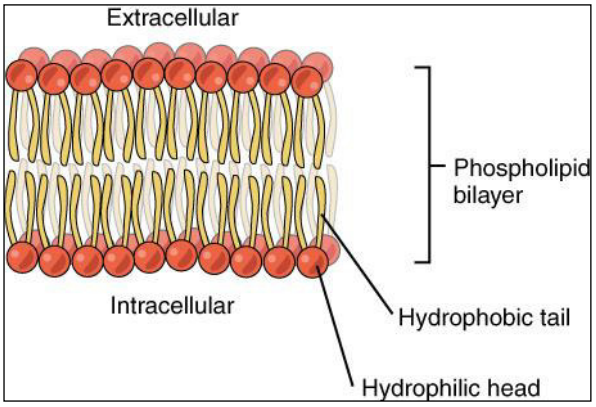

Fig. 2 Phospholipid bilayer[8]

Small molecules that are hydrophobic can easily pass through the cell membrane, because they are water-hating like the interior of the membrane. Molecules that are hydrophilic, on the other hand, cannot pass through the cell membrane-at least not without help-because they are water-loving like the exterior of the membrane, and are therefore excluded from the interior of the membrane. Phospholipids play multiple roles in cells, forming the permeability barrier of the cell membrane and support the intracellular organelles by providing surface for many catalytic processes. They actively participate in signal transduction in response to both external and internal stimuli, and provide precursors for signaling processes and macromolecular synthesis. As most of phospholipids are essential, phospholipids play multiple roles in cell function. Their primary role is to define the permeability barrier of cells and organelles. This bilayer is involved in important functions of the cell such as energy transduction, signal transduction, solute transport, DNA replication, protein targeting and cell recognition. [9, 10]

1.4 Steroids

A steroid is a biologically active organic compound with 4-hydro carbon structure or steroid nucleus as the foundation of their molecules. Steroids are differentiated mainly based on their side chain structure. All steroid hormones are derived from cholesterol. They are transported through the blood stream to the cells of various target organs where they carry out the regulation of a wide range of physiological functions[10].

1.5 Cholesterol

Cholesterol is an important steroid in the human body. It is a sterol, a type of lipid cholesterol biosynthesized by all animal cells and is an essential structure component of animal cell membranes. It is a yellowish crystalline solid. Cholesterol also serves as a precursor for the biosynthesis of steroid hormones, bile acid and vitamin D.

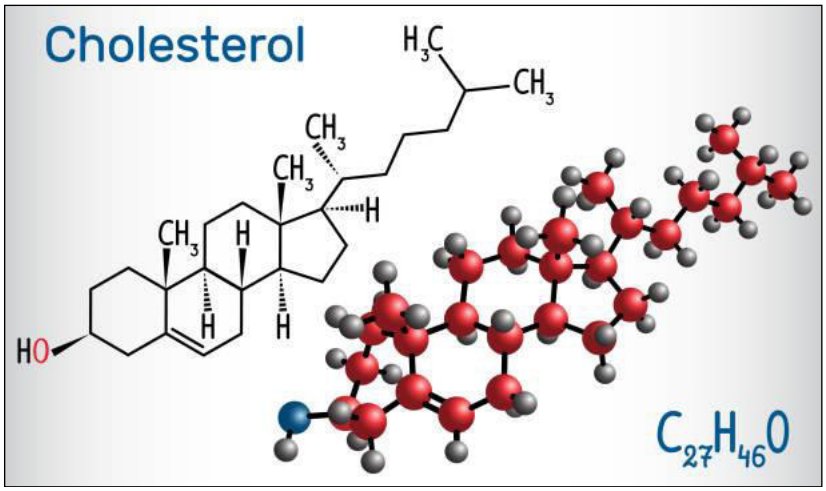

Fig. 3 Cholesterol[12]

About 30% of all animal cell membranes are composed of cholesterol. It is required to build and maintain membranes and modulates membrane fluidity. Within the cell membrane, cholesterol also functions in intracellular transport, cell signaling and nerve conduction. It is also implicated in cell signaling processes within cells. Cholesterol is also a precursor molecule for several biochemical pathways like the synthesis of vitamin D in the calcium metabolism and all steroid hormones. Cholesterol is recycled in the body by excretion into biliary fluids by liver. Hormones are often classified according to the organs that synthesize them. The adrenal steroids are so called because they are secreted by the adrenal cortex, and the sex hormones are those produced by the ovaries and testes. Such as cortisol, estrogen and testosterone.[11] These hormones comprise other important steroid compounds.[12]

1.6 Cortisol

Cortisol is one of the steroid hormones and is synthesized in the adrenal glands. Most cells within the body have cortisol receptors. Secretion of the hormone is controlled by the hypothalamus, the pituitary gland, and the adrenal gland. Cortisol is often called the "stress hormone" because of its connection to the stress response.

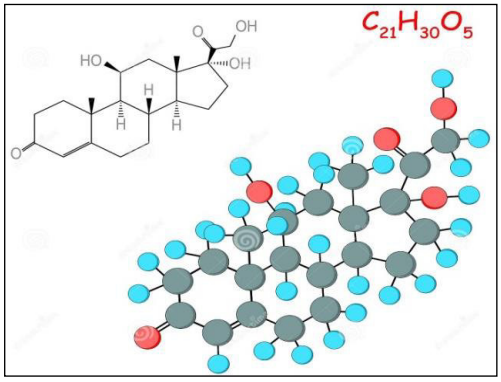

Fig. 4 Cortisol[13]

Cortisol can help control blood sugar levels, regulate metabolism, help reduce inflammation, and assist with memory formulation. It has a controlling effect on salt and water balance and helps control blood pressure. Cortisol also supports the developing fetus during pregnancy. All of these functions make cortisol a crucial hormone to protect overall health and well-being.[13]

1.7 Estrogen

Estrogen is a hormone that plays various roles in the body.
In females, it helps develop and maintain both the reproductive system and female characteristics. The ovaries, adrenal glands, and fat tissues produce estrogen. Both female and male bodies have this hormone, but females create more of it. The other one is progesterone. Estrogen helps control the menstrual cycle and is important for childbearing.

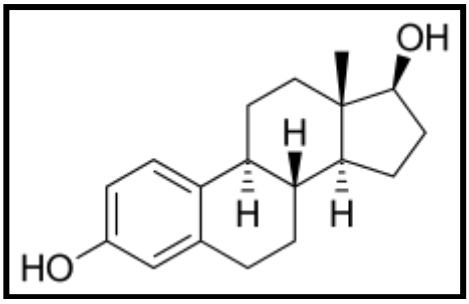

Fig. 5 Estrogen[14]

Estrogen keeps cholesterol in control, protects bone health for women and men, affects brain, bones, heart, skin and other tissues.[14]

1.8 Testosterone

Testosterone is a hormone found in humans, as well as other animals. In men, the testicles primarily make testosterone.

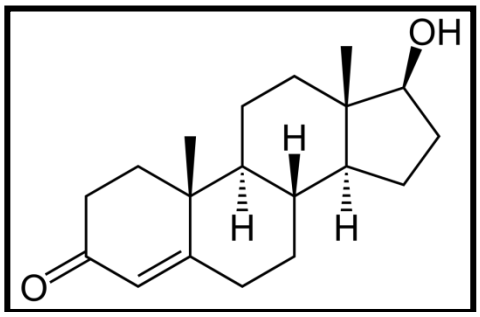

Fig. 6 Testosterone[15]

Testosterone is most often associated with sex drive and plays a vital role in sperm production. It also affects bone and muscle mass, the way men store fat in the body, and even red blood cell production. A man's testosterone levels can also affect his mood.[15]

1.9 Prostaglandins

Prostaglandins are small lipid molecules that are delivered from unsaturated fatty acids. Regulate numerous processors in the body, including kidney function, platelet aggregation, neurotransmitter release and modulation of immune function. Prostaglandin has diverse effects on the regulation and activity in the development and activity of B cells. There are many different types of prostaglandins in the body that take part in different important function, such as enhancing the immune system and inflammatory response.[16]

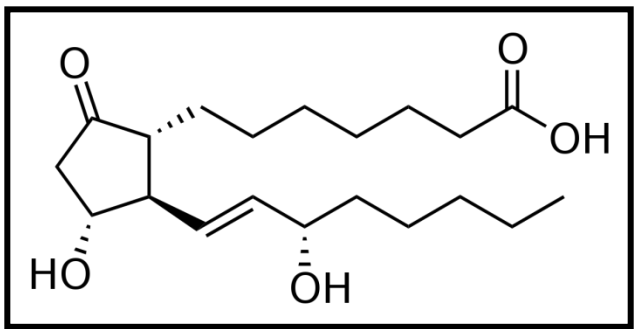

Fig. 7 Prostaglandins[17]

Prostaglandin is involved clearly in the promotion and persistence of carcinogenesis. There are reports of the inhibition of tumor cell growth, variety of tissues, including breast, prostate, colon, lung, bladder and esophagus acts in a myriad of ways to inhibit tumor genesis. Prostaglandin is emerging as a key anti-inflammatory mediator. The mechanism involves the inhibition of mitogen-activated protein kinases can induce the apoptosis of mouse T and B cells, a potential mechanism to down – regulate an inflammatory immune response. [17-19] A small amount of fatty acids is completely hydrolysed into glycerol and fatty acids. After hydrolysis these small molecules, such as glycerol, short-chain and medium-chain fatty acids, are absorbed into the blood by the small intestine. After the absorption of monoglycerids and long-chain fatty acids, triglycerides will be re-synthesized in small intestinal cells and along with phospholipids, cholesterol and proteins to form chylomicron from lymphatic system. Chylomicrons transported through lymphatic vessels eventually enter blood stream transported to liver, fat tissue as well can be stored (or) used by self. [8]

The liver and pancreas are important sites for lipid metabolism and play an important in the process of lipid digestion, synthesis, decomposition and transport. Lipids are insoluble in water, and lipids in plasma can only be transported to the body throughout the blood circulation by binding to proteins and becoming hydrophilic. [20,21]

1.10 Essential fatty acids

Fatty acids which are essential to human health but not produced in the body must be obtained through foods. Only two types of fatty acids, omega-3 (linolenic) fatty acids and omega-6 (linoleic) fatty acids are considered essential. Both are polyunsaturated fats. The 2015 Dietary Guidelines for Americans emphasize the use of vegetable oils (mono and polyunsaturated fats) as part of healthy eating pattern because they are the major source of essential fatty acids and vitamin E[11].Essential fat is highly essential for a healthy body and life. This type of fat is found in the brain, bone marrow and nerves. According to the "American council on Exercise", women need at least 10 to 13 percent of their body composition to come from essential fat to be in good health, while men require at least 2 to 5 percent[22].

1.11 Dietary fats

Dietary fats are important for several health related aspects and for optimal functioning of the human body. Dietary fats are not just a source of energy; they function as structural building blocks of the body, carry fat-soluble vitamins involved in vital physiological processes in the body and are indispensable for a number of important biological functions including growth and development.

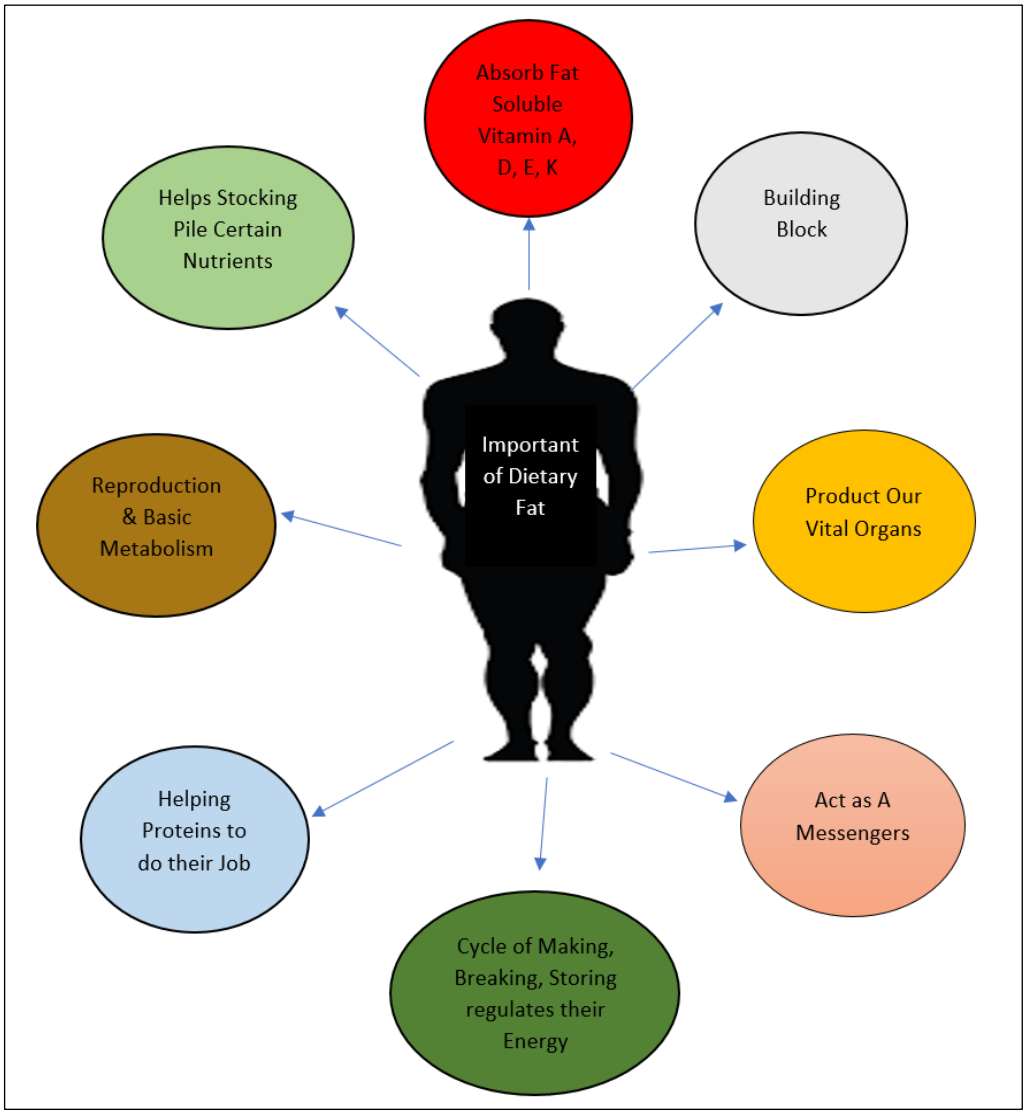

Fig. 8 Importance of Dietary Fats

1.12 Energy Source

Fats are a source of energy in the human diet, together with carbohydrates and proteins, the other two main macronutrients. Fat is the most concentrated source providing 9 kcal per 1 gram consumed, which is more than double the energy content of protein or carbohydrate (4 kcal per gram) and more than quadruple the energy content of fibre (2 kcal per gram). Fat can be stored in the body's fat tissue, which releases fatty acids when energy is required[23]. In the diet, fat is a carrier for the fat-soluble vitamins A, D, E and K, and supports their absorption in the intestine. Consuming sufficient amounts of fatty foods that contain these vitamins is thus essential for adequate intake of these micronutrients[23].

1.13 Structural component

The membranes around the cells in our body physically separate the in side from the out side of the cell, and control the movement of sub stances in and out of the cells. They are mainly made up of phospholipids, triglycerides and cholesterol. Both length and saturation of the fatty acids from phospholipids and triglycerides affect the arrangement of the membrane and thereby its fluidity. Shorter chain fatty acids and unsaturated fatty acids are less stiff and less viscous, making the membranes more flexible. This influences a range of important biological functions such as the process of endocytosis in which a cell wraps itself around a particle to allow its uptake. The human brain is very rich in fat (60%) and has a unique fatty acid composition; docosahexaenoic acid (DHA) is the major brain fatty acid. The lipids of the retina also contain very high concentrations of DHA[24].

1.14 Biological functions

Our bodies cannot produce the polyunsaturated fatty acids (PUFA) linoleic acid (LA) and alpha linolenic acid (ALA) as described in. Without these essential fatty acids some vital functions would be compromised, thus they must be provided by the diet. LA and ALA can be converted to longer chain fatty acids and compounds with hormone-like or inflammatory properties (such as prostaglandins or leukotrienes, respectively). As such, essential fatty acids are involved in many physiological processes such as blood clotting, wound healing and inflammation. Although the body is able to convert LA and ALA into the long chain versions arachidonic acid (AA), eicosapentaenoic acid (EPA), and, to a lesser extent, to docosahexaenoic acid (DHA), this conversion seems limited.[12] The longer chain fatty acids EPA and DHA are said to be "conditionally essential" and it is recommended to consume direct sources of these particular long chain fatty acids. The richest source of EPA and DHA is oily fish, including anchovy, salmon, tuna and mackerel. For a more complete overview of the most common fatty acids and foods in which they can be found. [25]

1.15 Effect of healthy fats

Healthy fats provide a number of benefits for human body and brain. Studies show that healthy fats like omega-3 fatty acids (found in fatty fish) are great for maintaining healthy cholesterol levels. Consuming these fats might help maintain healthy cholesterol levels and improve heart health. Promoting a healthy body composition by eating foods rich in healthy fats can help. Consuming sufficient amounts of healthy monounsaturated fats may promote fat loss. Thus, it is considered to be an excellent diet alternative for people who find it hard to comply with the high-carbohydrate and low-fat (HCLF) diet. The inflammatory pathways and coagulation markers are found to be improved by the use of Mediterranean diet. Good fats like omega-3 fatty acids play an important part in brain development and optimization of brain function. There are also studies demonstrating their role in improving mood, as well as their potential to help improve neurodegenerative mechanisms in the brain. Polyunsaturated fatty acids may help decrease liver fat. It is also found that omega-3 supplementation can improve liver health. There is a relationship between the consumption of monounsaturated fat and bone strength. Eating foods that are rich in essential fatty acids can improve bone health. Foods rich in healthy fats, like almonds and other types of nuts, might help improvement in the sleep pattern. Healthy skin requires essential fatty acids. This is because omega-6 and omega-3 polyunsaturated fats cause the rise of eicosanoids, which affects your skin's inflammatory response. Few studies reported that there may be a connection between polyunsaturated fat supplementation and blood sugar levels. It should be indicated that this healthy fat is essential in fostering glycemic control, help maintaining healthy blood sugar levels in people with insulin resistance[26]. Swapping healthy unsaturated fats for carbohydrates or saturated fats may reduce the risk of diabetes. Eating more unsaturated fats, in place of either carbohydrates or saturated fats lowers blood sugar levels and improves insulin resistance and secretion[27]. Unused carbohydrates and proteins are also converted into body fat[28].

1.16 Triglyceride levels and disease risk

High triglycerides levels are linked with heart disease, heart attack, and stroke in people with low "good" HDL cholesterol levels and type - 2 diabetes. Very high levels of triglyceride are associated with liver and pancreas problems. But studies show conflicting results on the role of high triglycerieds and the risk of heart disease. Not all experts agree that triglycerides play a significant role in heart problems. High triglycerides tend to show up along with other problems like high blood pressure, diabetes, obesity.[29] Making changes to lifestyle can have a dramatic benefit in maintaining the triglyceride levels. More physical activity and a 30 minutes exercise, at least five times a week or everyday walking may be very helpful in losing weight. Intake of lesser calories and avoiding sugary foods-like sodas, fruit drinks and soft drinks may also be useful. Eating fewer foods with unhealthy fats and avoiding trans fats (processed foods and margarines) plays important role in the triglyceride levels. Studies have found that the omega 3, 6 fatty acids like tune, salmon, sardines are particularly good at lowering triglycerides levels. Even small amount of alcohol seem to cause big spikes in triglyceride levels. [30,31]

1.17 Importance of Serum cholesterol level

Risk of heart disease is closely associated to the Cholesterol carried by the LDL and VLDL [32,33] and the ratio of total serum cholesterol to HDL-C serves as a better indicator [34]. A down regulation of the cholesterol production genes and the LDL receptors takes place when the cholesterol levels rise up and the protease cleavage does not activate SREBP-1. The promoters of the fatty acid synthesis and lipid storage genes are activated by SREBP-1 also [35]. The storage, utilization and oxidation of PUFAs by the liver are regulated by a variety of receptors or sensors[36]. The potential for the oxidation of the free radical is minimized by the stimulation of the fatty acid oxidation in the liver with the PUFAs. Coconut oil and dairy fat contain short-chain SFAs, which interact with the receptors coupled with G-protein and influence the gene expression. The overall energy metabolism of the body like those of insulin and leptin are linked to various hormonal responses [37]. Response to dietary PUFAs and short- or medium-chain SFAs is got through several sensors [38].

1.18 Fatty diet and health benefits

Chemically induced cancers are promoted by high-fat diets [39, 40]. Even though linoleic acid has been identified as the predominant v6 fatty acid in vegetables oils, it does not serve as a risk factor for the several cancers like breast, colorectal, and prostate cancers in humans [41]. But, few studies have reported that high intake of v6 relative to v3 PUFAs increases cancer risks [42 – 44] . Chemically induced tumors are promoted by the lipid peroxides [45], and PUFAs are highly susceptible to peroxidation of lipid. Nitrates used for preservation of processed meat is a well-known form of carcinogen, these secondary amines are seen under the acidic pH of the stomach [46]. As far as now, no association between the red meat and a very weak association between the processed meat and cancers like breast cancer [47] and prostate cancer [48] has been reported. No difference is found among the cancer risk with different types of fat. Most studies have reported the association of the levels of dietary fat in cancer risk. CAD events are not increased only due to the saturated fats but also due to many other factors like the preservatives used in processed meat and the related combination foods. Studies reported that even though the ratio of SFAs to MUFAs in palm oil is higher than that of olive oil, no significant effect was observed in the serum lipid levels of healthy volunteers. In contrary, there is a considerable increase in the serum HDL-C due to the SFAs present in coconut oil which gives a favorable lipid profile of the carbohydrates in the diet [49]. Tooth plaque and decay are prevented by the fatty acids of coconut oil and lauric acid present in milk [50]. Considerable reduction in the CAD risk factors like tissue plasminogen activator antigen and Lp (a) is observed with the use of coconut oil containing diets [51]. Total serum cholesterol levels are increased by the medium-chain SFAs present in milk fat and coconut oil, but a protective effect has been observed on HDL-C. A significant reduction in the CAD risk has been reported due to the increased ratio of dietary PUFAs to SFAs [52]. The ratio of unsaturated to SFA is highly influenced by other factors like life style of the individual with healthy habits and proper exercise, intake of diets rich in fibers and having low sugar levels.

1.19 Choice of lipids

Diets rich in carbohydrate and having less fats has been identified to increase the serum triglyceride levels as well as the dense LDL particles [53], which in turn increase the risk of CAD to a greater level when compared to serum total cholesterol or LDL-C to the . An increase in the triglyceride level is seen in contrary to the LDL-C or HDL-C levels when the dietary fat is replaced with carbohydrate [54]. A decrease in the serum total cholesterol and LDL-C levels can be maintained by increasing the PUFAs and decreasing the SFAs [55]. Milk contains may short chain SFAs that play an important role as the signaling agents in the immune system of children inspite of their excellent antibacterial and antiviral effects [56]. Lesser HDL proportions and higher levels of atherogenic oxidized LDL are found to be a reason for several infections in children [57]. A diet rich in sugar and less in healthy fats, oxidized LDL and low HDL may bring about enormous changes in the serum lipid profile which in turn increases the infections. Dyslipidemia and other metabolic syndromes like insulin resistance are influenced by the increased levels of plasma triglycerides. This increase may be attributed to the increase in VLDL and LDL levels brought about by high levels of fructose present in the diet [58]. The oxidation of PUFAs is highly associated with the ill effects that seem to spoil the health. As the saturated fats are not directly related to adverse effects, a revision in the dietary recommendations is highly solicited. Likewise, revisions are to be made in the recommendations of handling saturated fats in the diet.

1.20 Role of fats on growth

There is no significant effect reported in the growth process of a child due to the intake of fat in 6 – 24 months of age [59,60]. It has been seen that the growth velocity or energy density are not associated with the dietary fat levels while the energy density is influenced with the energy intake and weight gain at this age [61,62]. Intake of fat during these early days and indices of adiposity are not correlated to the fat intake or the body fat of the children [63]. Breastfed infants showed higher levels of cholesterol and LDL-C in blood when compared to a standard formula [64]. These levels automatically change when the diet is shifted to formula – fed pattern [65]. The fractional synthesis rate of cholesterol is highly controlled by the dietary cholesterol intake for a shorter period of time [66,67]. A positive association is seen with increased HDL-C levels which has been identified as the protective surrogate marker. But, the implications of breast feeding and intake of dietary cholesterol in early ages on the cardiovascular health remains uncertain [68].

1.21 Fat intakes and oxidation

Estimation of the bodily fat requirement is mainly based on the metabolic fate of the fats. The fat gets evenly distributed in different forms in the adipose tissue, lipoproteins in the form of circulating fats and in the cell membranes as structural fat. Energy production is based on the fat available in the oxidized form. As there is a limitation for the oxidation of fat in the body when compared to carbohydrates and proteins, the oxidation rate of the fat is limited to the fraction stored in the body [69]. There is a coordination in the intake of non-fat dietary components and their oxidation rates which is around 40 kcal kg_1 day_1 at 4months and gradually increases to 55 kcal kg_1 day_1 till the age of 2 years. Lowest oxidation rates and higher intakes of fats are seen in the initial days which show a progressive increase upto 30 kcal kg_1 day_1 at 4th month and gradually decrease to 20 kcal kg_1 day_1 at the age of 2yrs. This finding is supported by another report showing that 25% of total substrate fat oxidation is observed just after birth, around 25% of total substrate oxidation just after birth, then fat oxidation which rises to around 45% at 4 months and drops back to 25% again at the age of 2 years. Thus, it may be confirmed that in spite of the higher dietary intake of fat, the fat oxidation is suppressed greatly which gradually increases only after birth. In contrast, the oxidation of non – fat material follows the intake over the entire period. During gestation, the rate of glucose transfer across the placenta will be high and thus, the capacity for the oxidation of fats will be lowered than that of lipogenesis in the new born, which after birth, will be driven by the magnitude of a positive energy balance and the storage of fats in the first ages is well supported [70]. A reduction in the oxidation of fats can be attributed to the reduced intake of fat after the introduction of solids. There will be a preferential re-direction to fat storage in the first 24 months of age.

1.22 Dietary Fat and Metabolic syndrome

The criteria of metabolic syndrome (MS), which is a collective feature of development of adiposity, blood lipoprotein levels, arterial blood pressure and insulin sensitivity related to the intake of fat in paediatrics are discussed recently [71]. Data supporting the possibility of the association of the MS component and the early dietary fat in the first year are available. The fatty degeneration of the liver which is found in the obese and overweight children and adolescents is called as non-alcoholic fatty liver disease (NALFD) [72]. The insulin action is deranged specifically by the NALFD which is an additional feature of the metablic syndrome [73]. Studies report that quality of the fat ingested early may be associated with the expression of the disease. Liver conditions and insulin sensitivity are improved with the consumption of n-3 PUFA docosahexaenoic acid (DHA) for the first 6 months in children with NAFLD [74]. DHA belongs to the n-3 series of the polyunsaturated fats that play major roles in the point where the infants are adapted to a diet which is based on human milk model with high fat and low protein content. But, with the transition of age from 6 – 24 months, the advantage of this model has to be investigated further, specifically the contribution of a high protein and low fat diet in the metabolic impairments that occur in the later stages [75].

1.23 Fat and Body weight

Several organizations that promote health like the National Institutes of Health, the American Heart Association, American Cancer Society, and the American Diabetes Association have published many reports based on the researches carried out by the scholars in nutrition. These reports strongly registered that premature death and chronic diseases are caused mainly due to poor eating habits that must be changed for the public health improvement [76]. The Food guide pyramid booklet published by the USDA in 1992 focused mainly on fats as the American diet was rich in fat. The main reason behind this was that fat contains calories twice as that of the same amount of carbohydrates and proteins. Thus, a diet with less fat content helps in maintaining a healthy weight [77]. The intake of dietary fat and the calorie levels has been decreasing day by day due to the research focused on the fatty diet [78]. The adverse trend of the consumption of more fats and calories has been confirmed by the statistical studies. Several studies confirm that obesity is at the epidemic difficulty through the statistical reports released in 1998 itself [79]. Surgeon General David Satcher has stated that overweight and obesity may convert to be the cause for preventable disease and death same as cigarette smoking [80].

1.24 Significance of Monounsaturates

Monounsaturates or polyunsaturates can be used for the replacement of saturated fats. Oils with rich LA are the cheapest alternative for the dietary fats [81]. The effectiveness of LA that replaces the saturated fats in lowering the cholesterol levels has to be well studied. Oils with rich monosunstaurates also act as hypocholesterolemic as reported by early studies [82]. Similar to the US, many countries have become more westernized worldwide and thus the intake of fats with higher levels of LA has emerged [83]. Differentiation among LA and alpha linolenic acid (ALA) as well as their requirement was re-examined recently and it was established that 1-1.5% of LA level is enough to provide the entire omega 6 essential fatty acids required by the body for its growth and normal functioning [84,85]. The ability of LA in reducing the cholesterol levels when it is used to replace the saturated fats in the diet has long been claimed as healthy for humans [86]. The animal fats are replaced with the vegetable oils and there has been a tremendous increase in worldwide LA consumption [87]. Recent studies of Chris Ramsden and colleagues [88] have reported the formation of pro-inflammatory derivatives from LA. Clinical trials conducted on replacing the oils with low LA fats has reported a reduction in the severity of the head ache and occurrence of migraine 89,90[88,89]. Inflammatory components are found to be related to the LA or its metabolites present in the diet. It is necessary to check whether the reduction in the intake of LA will improve the clinical conditions and reduce the risk of heart diseases. Monosaturated fatty acids are rich in the mediterranean diets which may be used to replace the saturated fats with monounsaturated fats as reported by the two clinical trials of large scale [91,92]. Extensive reviews are carried out to identify the effect of Mediterranean diets in the health outcomes [93,94]. Replacing the saturated fats with the monounsaturates like OA comprise the rationale for the recommendation of a Mediterranean diet. Diets rich in OA elevates the blood ETrA levels which is disturbed by the deficiency of EFA and results in the growth reduction and skin rashes in rats 95,96[94, 95]. In humans, the ETrA levels are very high and they help in increasing the success of pregnancies without any ill effects. The synthesis of inflammatory mediators in animals is inhibited by ETrA [97,98]. The plasma DHA is regulated by the dietary LA amount. Dietary intake of omega 3 fatty acids have been researched and recommended extensively as a healthy diet component. The guidelines for the LA consumption are based on the assumption that the average LA consumption of ~6% en [99]. Diets with low levels of LA are conducive to higher levels of omega 3 polysaturates in the diet [100,101]. The availability of pre-formed omega 3 LCPUFA in higher levels may be the advantage of the Mediterranean diets with monounsaturated fats like meat, eggs and fish.

1.25 Dietary Guidelines

The major energy source for infants from 0 to 6 months is the dietary fat and an intake of 31 g/d seems to be the adequate level for this category. 30 g/d is been recommended for older infants of age 7 – 12 months based on the intake of human milk along with the other complementary foods. 20–35% of energy intake has been reported to be the acceptable macronutrient distribution range (AMDR) in case of adults. A dietary intake of n–3 and n–6 PUFA is required as they are not synthesized by the body like the SFAs or MUFAs. The levels of AI for n–6 and n–3 fatty acids amongst different group of individuals from 19 to 70 yrs have been reported in recent studies. AI for linoleic acid is 17 g/d in men and 12 g/d in women while it is 1.6 g/d for men and 1.1 g/d for women in the case of α-linolenic acid [102]. During pregnancy or lactation, there will be an increase in these AI as there are evidences showing the functional role of these fatty acids in the human body. The 20 carbon and other desaturated PUFAs are accepted as the essential metabolic forms. 5–10% and 0.6–1.2% of energy are considered to be the AMDR for n–6 and n-3 (linoleic acid) respectively. Eicosapentaenoic and docosahexaenoic

acid contribute ≤10% of this energy requirement [102]. Insufficient intake of dietary fats results in loss of weight and a negative energy balance will be observed. Several neurological abnormalities, scaly rash and poor growth are reported with the deficiency of n–3 and/or n–6 PUFAs in individuals suffering severe malnutrition or chronic mal absorption of fat. A wide range of fat intake can been adapted by individuals. Risk of obesity, type 2 diabetes, coronary heart disease and cancer has been increased with higher intake of SFA [103].

Reports about the low-carbohydrate and high-fat diets show a contradictory result about the impact of increased intake of SFAs in the risk levels [104]. Increased risk of many chronic diseases like CVD and cancer has been associated with low or imbalanced intake of n–6 and n–3 fatty acids [105].

1.26 Recent Findings

Current research is highly focused on the relation between dietary fat and health of an individual. New research reports state that a diet rich in fat can promote weight loss in a better manner than that with high carbohydrate content. Different SFAs exhibit different biological effects and the related risks are also varied. Increased intake of SFA may have an enhancement in the LDL-C levels which may not be correlated to the CVD risk. But it has been observed that the dietary fats have a reasonable positive influence in the biomarkers of CVD. With the findings of the genomics, it is established that the lipid levels and the biomarkers are altered by the dietary fats in a racial and ethnic pattern including different genetic phenotypes. Thus, in future there is a necessity of converting the fat recommendations for individualized patient rather than a population based. Previously known harmful and non-essential fatty acid groups like the MUFAs, medium chain fatty acids, long chain PUFAs and vaccenic acid are indentified to exhibit several health benefits. The effect of dietary fats in the regulation of inflammation in case of various conditions like obesity, type 2 diabetes, CVD and cancer are studied as inflammation is the major risk factor for almost all chronic diseases [106].

2. CONCLUSION

The word "fat" often has a negative impact on the population, but the body actually needs certain healthy fats to function properly like constructing cell membranes, insulate nerves, and ensure that many vitamins, including A, D, E, and K, work the way they should. Still all fats are vilified and limited as much as possible by most people. But this is absolutely not necessary, and limiting fat too much can even pose risks to human health. Fats are an essential part of healthy diet and they play a crucial role in some of our body's everyday functions. To conclude, it is observed that replacing the use of basic fats with foods rich in PUFAs with MUFAs has to be re-examined thoroughly. As indicated, the positive effects imparted by ETrA in various biological activities like the oxygenation of metabolites and the potential agonist activity has to be explored.

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