

Review Paper

# Fatty Food Consumption and Its Effects on Liver Health

Nalini Shahi\*, Neena Gupta and Akanksha Singh

Department of Public Health, Shalom Institute of Health & Allied Sciences, SHUATS, Prayagraj, Uttar Pradesh, India

\*Corresponding author: 21mph004@shiats.edu.in (ORCID ID: 0009-0006-8026-9764)

Received: 21-12-2022

Revised: 27-02-2023

Accepted: 05-03-2023

## ABSTRACT

Fat is essential for health. Some fats are beneficial for health & some are harmful. The type of fat consumed is more important than the amount of fat consumed. This is a review paper where different studies and views of various authors are observed for getting information and stats, many websites like Pubmed, Google Scholars etc and journals by the various author have been referred by the researcher. The consumption of dietary fats and its effect on health. Eating too much and the wrong kinds of fats, such as saturated and trans fat, may rise levels of low-density lipoprotein or LDL, or "bad" cholesterol. Elevated LDL cholesterol in the blood may increase a person's risk of heart disease, obesity, type 2 diabetes and liver disease. Both poly- and monounsaturated fats help in lowering low-density lipoproteins (LDL cholesterol) and subsequently reducing the risk of heart disease. It is recommended to consume a diet that is low in saturated and trans fats, and high in polyunsaturated fats, limiting the intake of most saturated fats and consuming enough unsaturated fats, is the ideal approach to a healthful diet in the long-term. Dietary changes can have unexpected effects on health, especially for people with underlying health conditions and heart problems.

## HIGHLIGHTS

- ① Fatty food consumption has become a major health concern in recent years, as it is associated with a wide range of health problems, including heart disease, diabetes, and liver disease.
- ① Fatty foods, such as those high in saturated and trans fats, are contribute to the development of non-alcoholic fatty liver disease (NAFLD) and its more severe form, non-alcoholic steatohepatitis (NASH).
- ① Saturated fats, which are found in animal products such as red meat and dairy, have been shown to have a particularly negative impact on the liver. On the other hand, polyunsaturated fats, which are found in foods such as nuts, seeds, and fish, have been shown to have a beneficial effect on liver health.
- ① The type and amount of fat consumed, as well as the overall dietary pattern, play important roles in the development of liver disease. To reduce the risk of liver disease, it's recommended to consume a diet that is low in saturated fat and high in polyunsaturated fat, and to limit the consumption of processed foods, refined carbohydrates, and added sugars.
- ① By adopting a healthy and balanced diet, individuals can reduce the risk of developing liver disease and other health problems associated with fatty food consumption.

**Keywords:** Dietary Fats, Saturated Fats, Trans-Fats, Unsaturated Fats, Nonalcoholic Fatty Liver

In recent decades, millions of people follow unhealthy lifestyles. Hence they encounter illness, disability and even death. Problems like metabolic diseases, hypertension, overweight, violence and so on, can be caused by unhealthy life style and diet is the greatest factor in lifestyle and has a direct relation with health

(Farhud, 2014). Healthcare systems, clinicians have

**How to cite this article:** Shahi, N., Gupta, N. and Singh, A. (2023). Fatty Food Consumption and Its Effects on Liver Health. *Int. J. Soc. Sci.*, 12(01): 33-41.

**Source of Support:** None; **Conflict of Interest:** None



focused on the medical, drug treatment model of disease rather than fundamental root causes such as diet and lifestyles (Micha *et al.* 2014). In 1961, the average Indian had a daily calorie intake of 2,010. Their daily diet consisted of 43% grains (378 g), 23% plant produce (199 g), 12% dairy & eggs (108 g), 12% sugar and fat (108 g), 2% meat (17g) and 8% as other (68 g). In 2011, the average Indian had a daily calories intake of 2,458. Their daily diet consisted of 34% plant produce (450 g), 32% grains (416 g), 18% eggs and dairy (235 g), 10% sugar and fat (129 g), 2% meat (29 g) and 4% as other (58g s) (Plummer, 2017). The main dietary changes observed have been an increased intake of caloric beverages, ultra-processed products, animal foods, edible oils and soft drinks, accompanied by substantial reductions in the consumption of fruits, vegetables, pulses and milk (Kac and Escamilla, 2013).

A small amount of fat is an essential part of a healthy, balanced diet. Dietary Fat is a source of essential fatty acids, which the body cannot make itself (NHS, 2020). Fats in the diet helps the body to absorb vitamins and minerals and serve other vital roles. Fats stored in body tissue are critical for the energy storage, metabolism, and the regulations of the body temperature (Tinsley and Felman, 2021). Dietary fats consist of a wide array of polar and non-polar lipids Triacylglycerol (TAG) which is the dominant fat in the diet, its contribute 90–95% of the total energy derived from dietary fat. in the diet, and are the main constituent of the body’s fat stores (Marshall and Lapsley, 2014). Saturated fatty acids (SFAs) are made up of a carbon chain with no double bonds (Devers and Brown, 2020). Many foods contain saturated fat, especially animal foods such as meat, butter and dairy products, and foods that are made with them, such as cakes and biscuits. They’re also found in some plant foods including coconut oil and palm oil (www.heartuk.org.uk). *Trans* fatty acids have  $\geq 1$  double bond in the *trans*, rather than *cis*, configuration, making them structurally more similar to SFAs (Field and Robinson, 2019). *Trans*-fats exist naturally in small amount in some meats and dairy products. However, they are also artificial added to many foods as partially hydrogenated oil foods with *trans*-fat are fried foods, margarine, non-dairy coffee creamer (Juber, 2022). Monounsaturated

fatty acids (MUFAs) have one double bond, and polyunsaturated fatty acids (PUFAs) have more than one double bond. The number of carbon atoms, the number of double bonds, and the places where double bonds are located differ in fatty acids (Kaçar, 2019). Almonds, nuts, walnuts, avocados, olive oil, canola oil are the main sources of MUFA. Mediterranean – style diets with plenty of carbohydrates are rich in unsaturated fatty acids are considered indicative of a healthy diet. (Oz *et al.* 2022). Polyunsaturated fatty acids including omega -3 and omega-6 fatty acids, are plentiful in fish oils and smaller amounts are present in some meats. (Hage, 2022).

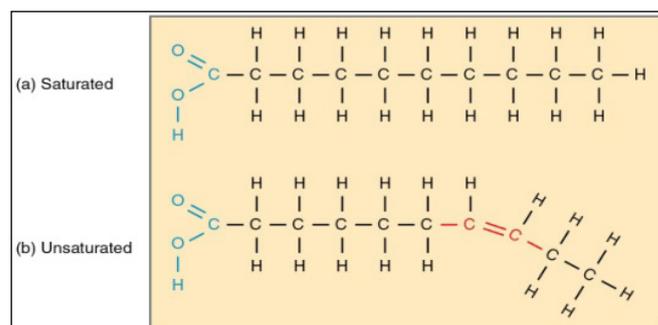


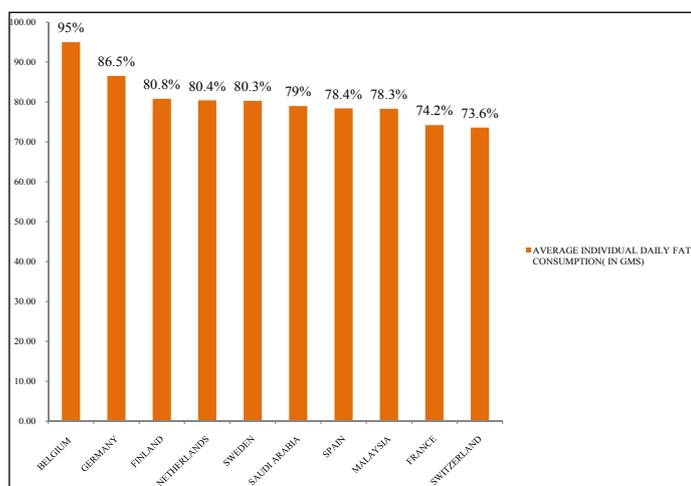
Fig. 1

The effect of fatty acids on health depends on their structure and quantity, plus the balance in relationship to other fatty acids (Powell and Wallace, 2020). The “diet-heart hypothesis”, postulated that a higher total dietary fat and saturated fatty acid (SFA) intake leads to an increased incidence of cardiovascular diseases (CVD) by increasing plasma total cholesterol (TC) and low-density lipoprotein-cholesterol (Julibert *et al.* 2019). Diet rich in saturated fatty acid induce a greater increase in liver fat and insulin resistance compared with isocaloric diets enriched with monounsaturated or polyunsaturated fatty acid (Parks *et al.* 2017).

### Top Dietary Fat Consuming Countries are —

In 2010, global saturated consumption was 9.4%E (95% UI = 9.2 to 9.5); country – specific intakes varied dramatically from 2.3 to 27.5 %E (Micha *et al.* 2014). According to 2007 estimates, the adult population in Belgium consumed 14.3% of their total calories intake

from saturated fatty acids (WHO, 2013). The global Trans fatty acid consumption in 2010, ranging from 0.2% to 6.5% of energy intake (Downs *et al.* 2017). In the UK, A considerable number of adolescents have intakes approximately 17% energy that may increase their risk of heart disease. Main sources of saturated fat in the adolescent diet include meat and meat products (approximately 20%), savory snacks and fried foods (Ruxton and Derbyshire, 2013).



**Fig. 2:** World atlas top fat consuming countries in the world march 2019

The average consumption of trans fat globally was estimated to be 1.4% of total energy in 2010, ranging from 0.2 to 6.5% of total energy across countries (0.123 to 4.3 grams per day for a 2,000-calorie diet) (WHO, 2018). The high fat diets induce greater food intake and weight gain than high carbohydrate diets (Agolay *et al.* 1997). According to WHO in 2019, an estimated 38.2 million children under the age of 5 years were overweight or obese. The prevalence of overweight and obesity among children and adolescents aged 5-19 has risen dramatically from 4% in 1975 to 18% in 2016. In 2016 more than 1.9 billion adults, 18 years and older were overweight. Of these over 650 million were obese (WHO, 2021). Nearly 3 in 4 adults age 20 or older in the United States have either overweight or obesity. Nearly 1 in 5 children and teens ages 2 to 19 years have obesity (NIH, 2022). More than 135 million individuals were affected by obesity in India.

According to ICMR-INDIAB 2015, prevalence rate of obesity and central obesity varies from 11.8% to 16.95% -31.3% respectively (Ahirwar and Mondal, 2019). Obesity or overweight is seen in 30-65% of the adult urban population. Body Mass Index (BMI) of urban Indians is higher (approximately 24-25) as compared with that of rural population (BMI of about 20) (Kumar and Sinha, 2020).

Saturated fat intake has been linked to an increased risk of cardiovascular disease, and this effect is thought to be mediated primarily by increased concentrations of LDL cholesterol (Tarino *et al.* 2010). CVDs caused by disorders of the heart and blood vessels, are the leading cause of death globally. It is estimated that 17.7 million people, which are represented 31% of all global deaths, died from CVDs in 2015 (Zhu *et al.* 2019). Heart attack and stroke are the biggest killers in Belgium and affect a significant part of the Belgium population. They account for 12% & 7% of all deaths respectively. (hpolicy.co/secondaryprevention, 2021). In 2016 India reported 63% of total deaths due to non-communicable diseases, of which 27% were attributed to CVDs. CVDs also account for deaths in the 40-69 year age group (WHO, 2023). Within India, the rates of CVD vary markedly with highest in states of Kerala, Punjab and Tamil Nadu. Moreover, these states also have the highest prevalence of raised cholesterol level and blood pressure (Kumar and Sinha, 2020). According to International Diabetes Federation in 2021, Approximately 537 million adults (20-79 years) are living with diabetes. More than 1.2 million children and adolescents (0-19 years) are living with type-1 diabetes (IDF, 2021). According to IDF, China (116 million), India (77 million), and the United States of America (31 million) are the countries with the highest numbers of people living with diabetes (Saeedi *et al.* 2019). The number of people with diabetes rose from 108 million in 1980 to 422 million in 2014 (WHO, 2022). Dietary pattern with lower average intakes of saturated fatty acids are associated with favorable cardiovascular outcomes (Kevin *et al.* 2021). The intake of high fat during the latter part of the third trimester of pregnancy may have long lasting impact on the baby's gut micro biome. The analysis showed that the mother's dietary intake of calories from fat ranged from 14.0%

to 55.2% per day. On an average, the daily intake of calories from fat was 33.1%. The Institute of medicine in the USA recommends the daily fat intake between 20% and 30% (Johanna, 2016).

The liver plays a major role in metabolic regulation of dietary nutrients including fat and carbohydrates. When fatty acids exceed the liver's capacity for removal (i.e., via secretion or oxidation pathways) they are stored as triglyceride (Green and Hodson, 2014). Overeating saturated fat from palm oil causes pronounced liver fat accumulation. In contrast, despite similar weight gain overeating polyunsaturated fatty acids from sunflower oil completely blocked liver fat accumulation, & even improved the blood lipid profile (Rosqvist *et al.* 2019). Excess fat which is deposited in the liver cause Nonalcoholic fatty liver (NAFLD). The prevalence of NAFLD in India is about 9% to 32% (National Health Portal, 2021). Hepatic fat accumulation can progress into advanced stages of liver disease such as non alcoholic steatohepatitis (NASH), liver cirrhosis, and hepatocellular carcinoma (Wernicke *et al.* 2023). Liver cirrhosis is leading cause of mortality and morbidity across the world. It is the 11<sup>th</sup> leading cause of death and 15<sup>th</sup> leading cause of morbidity. NAFLD has 24% estimated global prevalence rate, and it is more than 30% in the middle east and South America (Cheemerla and balakrishnan, 2021). NAFLD affects about 25% of the global adult population ranging from 13.5% in Africa to 31.8% in the Middle East (www.nhp.gov.in, 2021). According to a 2017 research review, NAFLD affects up to 25 to 30 percent of people in the United States and Europe (Sethi, 2023). Liver cancer is the 16<sup>th</sup> leading cause of death (Asrani *et al.* 2019). The burden of liver disease in India is significant because is alone contributed to 18.3% of the two million global liver disease related deaths in 2015 (Mondal *et al.* 2022). The effect of fat intake on NAFLD development depends on the type of fat. Same fats (MUFA and PUFA) protect against NAFLD whereas others (SFA and TFA) have a negative effect on NAFLD (Lujan *et al.* 2020). It is estimated that 3% to 7% of the US population has NASH (Armand, 2022).

Lifestyle includes many distinct elements of everyday life. Examples of lifestyle modification are numerous,

and include, apart from eating and drinking, physical activity, weight reduction, smoking, and stress (Vlachopoulos and Xaplanteris, 2015). Change in lifestyles, especially diet, has been shown to prevent or delay the onset of T2DM and its complications. Dietary management during the prediabetic stage involves significant changes in planning meals, selection and preparation of food, portion control, and eating away from home, which means most people struggle to comply (Zoidis *et al.* 2016). One large prospective trial of 261 patients followed for 12 months demonstrated that all features of NASH improved with weight loss of at least 10%, and fibrosis stabilized or improved with weight loss of at least 5%. Similarly, a meta-analysis of 8 randomized controlled trials suggested a weight loss of at least 5% resulted in improvement in hepatic steatosis, and weight loss of at least 7% improved the NASH (Feldman *et al.* 2021). The main goal of low-fat diets is to reduce the number of calories from fat. Some strategies are very low-fat, with calories from fat comprising less than 10% of total calories, while others are more moderate, with calories from fat comprising less than 30% of daily caloric intake (Baik and Bird, 2022). The WHO Healthy Diet Fact Sheet advises that "unsaturated fats are preferable to saturated fats". This advice is echoed by 29% of countries having key message that indicate preference for unsaturated over saturated fats (e.g., "Limit intake of solid fats and replace with vegetable oils": Lebanon) (Herforth *et al.* 2019).

The report, written on behalf of the Global Burden of Diseases Nutrition and Chronic Diseases Expert Group, was published online April 15, 2014 in the British Medical Journal (BMJ).

- ❖ Between 1990 and 2010, global saturated fat, dietary cholesterol, and trans fat intakes remained stable, while omega 6, seafood omega 3, and plant omega 3 fat intakes each increased.
- ❖ In 2010, global saturated fat consumption averaged 9.4%; country-specific intakes varied dramatically from 2.3 to 27.5%. The world's highest consumption of saturated fat in adults in 2010 was in Samoa, Kiribati, and similar palm oil producing island nations, as well as Sri Lanka, Romania, and Malaysia. The lowest intake was in Bangladesh,

Nepal, Bolivia, Bhutan, and Pakistan.

- ❖ Country-specific consumption of trans fat ranged from 0.2 to 6.5% (global mean: 1.4%) for trans fat; and for dietary cholesterol, from 97 to 440 mg/day (global mean: 228 mg/day).
- ❖ Globally, the average intake of seafood omega-3's was 163 mg/d, but with tremendous national variation from 5 to 3,886 mg/d. Highest intakes were identified in island nations including Maldives, Barbados, the Seychelles, and Iceland; as well as in Malaysia, Thailand, Denmark, South Korea, and Japan. 100 nations had very low consumption (<100 mg/d), generally in Sub-Saharan African and Asian regions as well as North Africa and the Middle East, representing 3 billion adults and 66.8% of the world's adult population

(Dwyer, 2014).

A standard low fat diet contains about 30% or less of its calories from fat. Here are a few examples of suggested daily fat ranges for a low fat diet, based on different calorie goals:

- ❖ **1,500 calories:** about 50 grams of fat per day
- ❖ **2,000 calories:** about 67 grams of fat per day
- ❖ **2,500 calories:** about 83 grams of fat per day

(Spritzler and Kubala, 2020)

The 2015-2020 Dietary Guidelines for Americans recommends limiting calories from fats to less than 10% of the total calories. That's about 200 calories for a 2,000 calorie diet (Dietary Guidelines For Americans, 2015-2020) According to the institute of Medicine's food and nutrition board on acceptable macronutrient distribution range for fat, the suggested goal is to maintain a total dietary fat intake of 20 to 35 percents for adults, 30 to 40 percent for children ages 1 to 3, and 25 to 35 percent for children ages 4 to 18 (Schere *et al.* 2023). Total fat should not exceed 30% of total energy intake. Intake of saturated fats should be less than 10% of total energy intake, and intake of trans-fats less than 1% of total energy intake, with a shift in fat consumption away from saturated fats and trans-fats to unsaturated fats, and towards the goal of eliminating industrially-produced trans-fats (WHO,

**Fig. 3:** Recommendations for dietary fat intake in Indians

Age/Gender/ physiological groups	Physical activity	Minimum level of Total fat (% E)	Minimum level* of fat from foods other than visible fats <sup>d</sup> % E	Visible fat	
				% E	g/p/d
Adult Men	Secondary	20	10	10	25
	Moderate				30
	Heavy				40
Adult Women	Secondary	20	10	10	20
	Moderate				25
	Heavy				30
	Pregnant women	20	10	10	30
	Lactating women				30
Infants	0-6 m	40-60			Human milk
	6-24	35	10 <sup>c</sup>	25	25
Children	3-6 y	25	10	15	25
	7-9 y				30
Boys	10-12 y	25	10	15	35
	13-15 y				45
	16-18 y				50
Girls	10-12 y	25	10	15	35
	13-15 y				40
	16-18 y				35

<sup>a</sup>if higher than 10% E, visible fat requirement proportionately reduces; (ICMR – NIN, 2020).

2018). The American Heart Association recommends aiming for a dietary pattern that achieves 5% to 6% of calories from saturated fat. For example, if body needs about 2,000 calories a day, no more than 120 of them should come from saturated fat. That's about 13 grams of saturated fat per day (American Heart Association).

Fish and marine n-3 fatty acid consumption among Asian populations was associated with a decreased risk for type 2 diabetes, consumption of these among western Europeans and Americans was associated with increased of the disease (Bardley, 2018).

Eating foods higher in monounsaturated fat compared to food higher in saturated fat may have some benefits in the context of a moderately high carbohydrate intake-46% of total calories from carbohydrates, where replacing saturated fats with monosaturated might lead to less body fat gain (DiNicolantonio *et al.* 2022). In May 2018, the Health Assembly approved the 13th General Programme of Work (GPW13), which will guide the work of WHO in 2019–2023. Reduction of salt/sodium intake and elimination of industrially-produced trans-fats from the food supply are identified in GPW13 as part of WHO's priority actions to achieve the aims of ensuring healthy lives and promote well-being for all at all ages (WHO).

The nutrition labels on the food packaging can help to cut down on total fat and saturated fat.

Total fat- High fat; more than 17.5 g of fat per 100 g. Low fat; 3 g of fat or less 100 g, or 1.5 g of fat per 100 ml for liquids. Fat –free; 0.5 g of fat or less per 100 g or 100 ml.

Saturated fat- High saturated fat- more than 5 g of saturates per 100 g. Low saturated fat- 1.5 g of saturates or less per 100 g or 0.75 g per 100 ml for liquids. Saturated –fat – free; 0.1 g of saturates per 100 g or 100 ml.

Lower fat-For a product to be labeled lower fat, it must contain at least 30% less fat than a similar product. If the type of food in question is usually high in fat, the lower fat version may still be a high – fat – food (17.5 g or more of fat per 100 g) (www.nhs.uk.2022).

## OBJECTIVE

The consumption of dietary fats and its effect on health.

## METHODOLOGY

This is a review paper where different studies and views of various authors are observed for getting information and stats, many websites like Pubmed, Google Scholars etc and journals by the various author have been referred by the researcher.

## DISCUSSION

Worldwide non-communicable diseases, such as cardiovascular disease, cancer and type 2 diabetes account for more than 70% of total death. Cardiovascular diseases remain the leading cause of disease burden in the world. According to the *International Diabetes Federation* more than 500 million adults are living with diabetes. Up to 4% of the global disease burden has been related to an unhealthy diet, making diet one of the important modifiable lifestyle factors. Over several decades, dietary habits have changed dramatically around the world. Globalization and urbanization have paved the way for a rise in convenience food and drinks products, junk food, and eating out. Junk foods are food that lacks nutrients, vitamins and minerals, and are high in salts, sugar, and fats. Small amount of fat or dietary fat is essential part of a healthy, balanced diet. Fat helps the body absorb Vitamin A, Vitamin D and Vitamin E. These vitamins are fat-soluble, which means they can only be absorbed with the help of fats. The types of fats have different chemical structures and physical properties. The “bad fats”, saturated and trans-fats tend to be more at solid room temperature. Monounsaturated and polyunsaturated fats tend to be more liquid. Saturated fatty acids (SFAs) are made up of a carbon chain with no double bonds. They are mainly obtained through dietary intake of animal fats like beef, cheese, and ice cream but a few plant foods are also high in saturated fats, such as palm oil, palm kernel oil and coconut oil. 92% saturated fat is present in coconut oil. Trans fats is considered the worst type of fat to eat. Trans-fats are formed through an industrial process that adds hydrogen to vegetable oil, which causes the oil to become solid at room temperature. According to WHO (2018) high intake of trans fats increase the risk of death from any cause by 34% and from coronary heart

disease by 28%. The average consumption of trans-fat globally was estimated to be 1.4% of total energy in 2010, ranging from 0.2 to 6.5% of total energy across countries. Approximately 540,000 deaths each year can be attributed to intake of industrially produced trans-fatty acids. Mother's high – fat diet may have a lasting impact on babies gut micro biome. Changes in the baby's gut micro biomes were present from birth to six weeks of age. The changes in gut micro biome may affect the baby's immune development (Johanna, 2022). Diet rich in saturated fatty acid induce a greater increase in liver fat .The liver plays a major role in metabolic regulation of dietary nutrients including fat and carbohydrates. The accumulation of fat within the liver represents an imbalance between the amount of fatty acids entering the liver (input), fatty acids synthesis within the liver and fatty acid disposal from the live (output). The excess deposition of fat in liver is the cause of Nonalcoholic fatty liver disease (NAFLD). NAFLD is currently recognized as the most prevalent form of liver disease world-wide, estimated to affect 25% of the global population. The highest prevalence of is reported from the Middle East with 31.79%, followed by South America with 30.45% and the least prevalent rate is Africa with 13.48% (Armandi and Bugianesi, 2021). Hepatic fat accumulation can progress into advanced stages of liver disease such as non alcoholic steato hepatitis (NASH), liver cirrhosis, and hepato cellular carcinoma. It is estimated that 9%-32% of general population in India has NAFLD and among them nearly 31% are diagnosed with NASH (National Health Portal, 2021). NAFLD is frequently linked to metabolic syndrome, which includes diabetes, hyper lipidemia, obesity, hypertension, etc. Increase in LDL cholesterol levels is associated with an increased risk of cardiovascular diseases. Since saturated fat increases LDL cholesterol while unsaturated fat decreases it, replacing saturated fat with unsaturated fat will lower the risk of these diseases. Monounsaturated fatty acids (MUFAs) are found in olive oil, avocados and nuts. A decreased risk of metabolic syndrome and/or cardiovascular disease has been evidenced with a higher Monounsaturated fatty acids consumption. Essential polyunsaturated fatty acids include omega-3 Poly unsaturated fatty acids and omega-6 Polyunsaturated fatty acids. The latter are mostly found in vegetable oils

(canola and cottonseed), cereal grains (wheat, maize and rice) and nuts. Linoleic acid is the main dietary omega-6 Poly unsaturated fatty acids. All types of fat are high in energy. A gram of fat, whether it's saturated or unsaturated, provides 9kcal (37kj) of energy compared with 4kcal (17kj) for carbohydrate and protein. All packaged foods have a nutrition label that includes fat content. Reading food labels can help to keep track. As a guide, when comparing or readings labels then 5% of daily value from fats is low and 20% of daily value from fats is high (WWW.NHS.UK, 2020).

**CONCLUSION:** After reviewing many articles it was decided that fat is essential for health. Some fats are beneficial for health like MUFS and PUFA & some are harmful like saturated fat and trans fats. Many foods contain saturated fat, especially animal foods such as meat, butter and dairy products, and foods that are made with them, such as cakes and biscuits. They're also found in some plant foods including coconut oil and palm oil. Unsaturated fats are predominantly found in foods from plants, such as vegetable oils, nuts, and seeds. Saturated fat may increase levels of low-density lipoprotein or LDL, or "bad" cholesterol. Elevated LDL cholesterol in the blood may increase a person's risk of heart disease. Other than cardiovascular disease saturated fat can also cause obesity, type 2 diabetes and liver disease. Both poly- and monounsaturated fats help in lowering low-density lipoproteins (LDL cholesterol) and subsequently reducing the risk of heart disease. Some consider polyunsaturated fats as being marginally better for their health. To reduce the risk of liver disease and other health problems associated with fatty food consumption. It is recommended to consume a diet that is low in saturated and trans fats, and high in polyunsaturated fats, limiting the intake of most saturated fats and consuming enough unsaturated fats, such as plant oils, avocado, and fish, is the ideal approach to a healthful diet in the long-term. Dietary changes can have unexpected effects on health, especially for people with underlying health conditions and heart problems.

## REFERENCES

Ahirwar, R. and Mondal, P.R. 2019. Prevalence of obesity in India: A systematic review. *Diabetes Metab. Syndrome*, **13**(1): 318-321.

- Angelo, A. and Bugianesi, E. 2021. Natural history of NASH, *Liver International*, **41**(Suppl 1): 78–82.
- Asrani, S.K., Devarbhavi, H., Eaton, J. and Kamath, P.S. 2019. Burden of liver diseases in the world, *Journal of Hepatology*, **70**(1): 151-171.
- Baik, D. and Bird, K. 2022. Dietary Lifestyle Changes StarPearls, Nov 27.
- Beth H. Rice Bradley, 2018. Dietary Fat and Risk for Type 2 Diabetes: a Review of Recent Research. *Current Nutrition Reports*, **7**(4): 214-226.
- Catherine J Field and Lindsay Robinson, 2019. Dietary Fats, *Dietary Fats Advances In Nutrition*, **10**(4): 722–724.
- Charalambos Vlachopoulos, Panagiotis Xaplanteris, Lifestyle Intervention: What Works? Early Vascular Aging (EVA), <https://doi.org/10.1016/B978-0-12-801387-8.00026-0>. (<https://www.sciencedirect.com/science/article/pii/B9780128013878000260>)
- Charlotte J. Green and Leanne Hodson, 2014. *The Influence of Dietary Fat on Liver Fat Accumulation Nutrients*, **6**(11): 5018–5033.
- Cheemerla, S. and Balakrishnan, M. 2021. Global Epidemiology of Chronic Liver Disease. *Clinical Liver Disease (Hoboken)*, **17**(5): 365-370.
- Dariush D. Farhud, 2015. Impact of lifestyle on Health, *Iran Journal of Public Health*, **44**(11): 1442-4.
- Dietary guidelines for Americans 2015-2020 Cut Down on Saturated Fats 2016 Dec
- Downs, S.M., Bloem, M.Z., Zheng, M., Catterall, E., Thomas, B., Veerman, L. and Wu, J.H. 2017. The Impact of Policies to Reduce trans Fat Consumption: A Systematic Review of the Evidence, *Current Developments in Nutrition*, **1**(12): cdn.117.000778.
- Fat : the facts, WWW.NHS.UK, April 2020, (<https://www.nhs.uk/live-well/eat-well/food-types/different-fats-nutrition/>)
- Food labels, [www.nhs.uk, 16 September 2022](https://www.nhs.uk/live-well/eat-well/food-guidelines-and-food-labels/how-to-read-food-labels/), (<https://www.nhs.uk/live-well/eat-well/food-guidelines-and-food-labels/how-to-read-food-labels/>)
- Franziska Spritzler and Jillian Kubala 2020. Fat grams – how much fat should you eat per day ? [www.healthline.com](https://www.healthline.com/health/fat-grams/) 2020 october
- Golay, A. and Bobbioni, E. 1997. The role of dietary fat in obesity, *Int. J. Obes. Relat. Metab. Disord.*, **3**: S2-11.
- Grant Tinsley and Adam Felman, 2021. Is saturated or unsaturated fat better for health? *Medical News Today*, Updated on Jan 27.
- Herforth, A., Arimond, M., Álvarez-Sánchez, C., Coates, J., Christianson, K. and Muehlhoff, E. 2019. *A Global Rev. Food-Based Dietary Guidelines, Advances in Nutrition*, **10**(4): 590-605.
- International Diabetes Federation, Diabetes facts & figures, 19 Dec 2021 (<https://idf.org/aboutdiabetes/what-is-diabetes/facts-figures.html>)
- Jahangir Iqbal and Mahmood Hussain, M. 2009. Intestinal Lipid Absorption. *American Journal of Endocrinology and Metabolism*, **296**(6): E1183-94.
- James J. Di Nicolantonio and James H. O’Keefe, 2022. Monounsaturated Fat vs Saturated Fat: Effects on Cardio-Metabolic Health and Obesity. *Missouri Medicine*, **119**(1): 69-73.
- Julibert, A., Bibiloni, M.D.M., Mateos, D., Angullo, E. and Tur, J.A. 2019. Dietary Fat Intake and Metabolic Syndrome in Older Adults, *Nutrients*, **11**(8): 1901.
- Kac, G. and Pérez-Escamilla, R. 2013. Nutrition transition and obesity prevention through the life-course, *International Journal Of Obesity Supplements*, **3**(Suppl 1): S6–S8.
- Lahnor Powell, Edward C. Wallace, Fatty Acid Metabolism, Textbook of Natural Medicine (Fifth Edition), doi: <https://doi.org/10.1016/B978-0-323-43044-9.00079-0>, (<https://www.sciencedirect.com/science/article/pii/B9780323430449000790>)
- Lucy Plummer, 2017. 50 Years of food in India: Changing Eating Habits of a Rapidly Changing Nation (of Foodies), The Better India, May 2.
- Mahammad Juber, 2022. *Foods High in Trans Fat*, WebMD.
- Maki Kevin, C., Dicklin, M.R. and Kirkpatrick, C.F. 2021. Saturated fats and cardiovascular health: Current Evidence and controversies, *Journal of Clinical Lipidology*, **15**(6): 765-772.
- Marge Dwyer, Report compares dietary fat intake among countries, [www.hsph.harvard.edu](https://www.hsph.harvard.edu/news/features/report-outlines-dietary-fat-intake-among-266-countries/), April 17 2014, (<https://www.hsph.harvard.edu/news/features/report-outlines-dietary-fat-intake-among-266-countries/>)
- Mondal, D., Das, K. and Chowdhury, A. 2022. Epidemiology of Liver Diseases in India, *Clinical Liver Disease (Hoboken)*, **19**(3): 114–117.
- Mustafa ÖZ, İlknur Ucak, Gulzar Ahmad Nayik, 2022. PUFA and MUFA, Nutraceuticals and Health Care, <https://doi.org/10.1016/B978-0-323-89779-2.00004-1>, (<https://www.sciencedirect.com/science/article/pii/B9780323897792000041>)
- Nadia El-Hage, Scialabba, 2022. Livestock food and human nutrition Managing Healthy Livestock Production and Consumption, <https://doi.org/10.1016/B978-0-12-823019-0.00012-X>. (<https://www.sciencedirect.com/science/article/pii/B978012823019000012X>)
- National Health Portal, Nonalcoholic fatty liver disease (NAFLD), Apr 04, 2021, (<https://www.nhp.gov.in/disease/non-communicable-disease/nonalcoholic-fatty-liver-disease-nafld>)
- National Institutes of Health, What Are Overweight and Obesity? March 24, 2022, (<https://www.nhlbi.nih.gov/health/overweight-and-obesity>)
- Parks, E., Yki-Järvinen, H. and Hawkins, M. 2017. Out of the frying pan: dietary saturated fat influences nonalcoholic fatty liver disease, *Journal of Clinical Investigation*, **127**(2): 454-456.

- Patricia M. Devers, Warren M. Brown, 2020. Fatty Acid Profiling, Textbook of Natural Medicine (Fifth Edition), <https://doi.org/10.1016/B978-0-323-43044-9.00013>, (<https://www.sciencedirect.com/science/article/pii/B9780323430449000133>)
- Renata Micha, Shahab Khatibzadeh, Peilin Shi, Saman Fahimi, Stephen Lim, Kathryn G Andrews, Rebecca E Engell, John Powles, Majid Ezzati, Dariush Mozaffarian, 2014. Global, regional, and national consumption levels of dietary fats and oils in 1990 and 2010: A systematic analysis including 266 country-specific nutrition surveys, *The British Medical Journal*, **348**.
- Rosqvist, F., Kullberg, J., Ståhlman, M., Cedernaes, J., Heurling, K., Johansson, H.E., Iggman, D., Wilking, H., Larsson, A., Eriksson, O., Johansson, L., Straniero, S., Rudling, M., Antoni, G., Lubberink, M., Orho-Melander, M., Borén, J., Ahlström, H. and Risérus, U. 2019. Overeating Saturated Fat Promotes Fatty Liver and Ceramides Compared With Polyunsaturated Fat: A Randomized Trial, *Journal of Clinical Endocrinology and Metabolism*, **104**(12): 6207-6219.
- Ruxton, C.H.S. and Derbyshire, E. 2013. Adolescents: Requirements for Growth and Optimal Health Encyclopedia of Human Nutrition (Third Edition), <https://doi.org/10.1016/B978-0-12-375083-9.00003-9>. (<https://www.sciencedirect.com/science/article/pii/B9780123750839000039>)
- Saeedi, P., Petersohn, I., Salpea, P., Malanda, B., Karuranga, S., Unwin, N., Colagiuri, S., Guariguata, L., Motala, A.A., Ogurtsova, K., Shaw, J.E., Bright, D., Williams, R. 2019. IDF Diabetes Atlas Committee. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9<sup>th</sup> edition. *Diabetes Research and Clinical Practice*, **157**: 107843.
- Saturated Fat, AMERICAN HEART ASSOCIATIONS (<https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/saturated-fats>), Nov 1, 2021
- Saturated fat, [www.heartuk.org/low-cholesterol-foods/saturated-fat](http://www.heartuk.org/low-cholesterol-foods/saturated-fat)
- Secondary prevention of heart attack and stroke Country Profile for Belgium, 2021, (<https://www.healthpolicypartnership.com/app/uploads/Secondary-prevention-of-heart-attack-and-stroke-in-Europe-Belgium>.)
- Semra Kacar, 2019. n-3 and n-6 fatty Acids in fish: A Focus on Non-Marine Species Science Direct, 11 July 2019.
- Sethi, S. 2023. *What to Know About Fatty Liver Disease*, <https://www.healthline.com/health/fatty-liver>, Feb 8.
- Shirley Johanna, 2016. High – fat Diet during Pregnancy may affect Baby’s Gut Microbiome Medindia, August-2016.
- Siri-Tarino, P.W., Sun, Q., Hu, F.B. and Krauss, R.M. 2010. Saturated fatty acids and risk of coronary heart disease: modulation by replacement nutrients, *Current Atherosclerosis Reports*, **12**(6): 384-90.
- Sreeniwass Kumar, A. and Sinha, N. 2020. Cardiovascular disease in India: A 360 degree overview. *Medical Journal Armed Forces India*, **76**(1): 1-3.
- Vancells Lujan, P., Viñas Esmel, E. and Sacanella Meseguer, E. 2021. Overview of Non-Alcoholic Fatty Liver Disease (NAFLD) and the Role of Sugary Food Consumption and Other Dietary Components in Its Development. *Nutrients*, **13**(5): 1442.
- Wernicke, C., Pohrt, A., Pletsch-Borba, L., Apostolopoulou, K., Hornemann, S., Meyer, N., Machann, J., Gerbracht, C., Tacke, F., Pfeiffer, A.F., Spranger, J. and Mai, K. 2023. Effect of unsaturated fat and protein intake on liver fat in people at risk of unhealthy aging: 1-year results of a randomized controlled trial. *American Journal of Clinical Nutrition*, **13**: S0002-9165(23)00514-2.
- WHO, Cardiovascular diseases, 2023.
- WHO, Diabetes, 16 September 2022
- WHO, Nutrition: Trans fat, 3 May 2018
- WHO, Obesity and overweight, 9 June 2021.
- William J. Marshall, Marta Lapsley, 2014. Uses of biochemical data in clinical medicine, *Clinical Biochemistry: Metabolic and Clinical Aspects* (Third Edition) <https://doi.org/10.1016/B978-0-7020-5140-1.00001-8>. (<https://www.sciencedirect.com/science/article/pii/B9780702051401000018>)
- WORLD ATLAS, Top fat consuming countries in the world 2019
- World Health Organization European Region Nutrition, Physical Activity and Obesity Belgium, 2013
- Wynne Armand, Fatty liver disease: What it is and what to do about it, Harvard Health Blog, (<https://www.health.harvard.edu/blog/fatty-liver-disease-what-it-is-and-what-to-do-about-it-2019011015746>), April 14, 2020
- Zhu, Y., Bo, Y. and Liu, Y. 2019. Dietary total fat, fatty acids intake, and risk of cardiovascular disease: a dose-response meta-analysis of cohort studies. *Lipids Health Disease*, **91**.
- Zoidis, E. and Papamikos, V. 2016. Glucose: Glucose Intolerance Encyclopedia of Food and Health, <https://doi.org/10.1016/B978-0-12-384947-2.00352-4>. (<https://www.sciencedirect.com/science/article/pii/B9780123849472003524>)