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The Dietary Fats: A Comprehensive Study about the Influence of Different Types of Fats on General Health and Developing Diseases

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ABSTRACT

Introduction and Purpose: One of the main reasons for the increased risk of non-communicable diseases is improper dietary habits. In recent years, studies on the composition and nutritional value of the diet have been intensively developed to establish the relationship between nutrition and the occurrence of diseases. The study presents current knowledge regarding the relationship between the type of fats consumed with food and the risk of all cause mortality, cardiovascular disease, and type 2 diabetes.

Materials and Methods: The review is based on a detailed analysis of peer-reviewed studies from major scientific databases such as PubMed. The article is a comprehensive review of current literature, including clinical studies and trials on dietary fats' influence in developing non-infectious diseases and general cardiovascular health.

Results:

1) Saturated fats are not associated with all cause mortality, CVD, CHD, ischemic stroke, or type 2 diabetes, but the evidence is heterogeneous with methodological limitations.
2) Trans fats are associated with all cause mortality, total CHD, and CHD mortality, probably because of higher levels of intake of industrial trans fats than ruminant trans fats. Dietary guidelines must carefully consider the health effects of recommendations for alternative macronutrients to replace trans fats and saturated fats.

Conclusion: It was found that the isomers of trans fatty acids (TFAs) in particular promote the development of coronary heart disease, causing undesirable changes in the blood lipid profile, therefore it is necessary to seek to reduce their content in the diet by limiting the consumption of fats cured by partial hydrogenation of products produced with their use. Long-chain polyunsaturated fatty acids – eicosapentaenoic acid and docosahexaenoic acid, contribute to reducing the risk of death from ischaemic heart disease and heart attacks.

Keywords: dairy fat, saturated fat, polyunsaturated fat, coronary heart disease, type 2 diabetes mellitus

Introduction

Dietary fats, also known as lipids, are a group of macronutrients that are essential for human health. They are composed of fatty acids and glycerol, and they come in various forms, including saturated fats, unsaturated fats (monounsaturated and polyunsaturated), and trans fats. When talking about fats' role in health we usually use only names of fatty acids they consist of, due to the nonsignificant role of glycerol.

Types of Dietary Fats

Dietary fats consumption should be balanced and tailored to individual needs, they are indispensable for maintaining optimal physiological function and preventing chronic diseases. Understanding the types and roles of dietary fats is key to making informed nutritional choices.

Structure-based classification:

- Saturated fatty acids (SFA)
- Trans fatty acids (TFA)
- Unsaturated fatty acids
- Monounsaturated fatty acids (MUFA)
- Polyunsaturated fatty acids (PUFA)
    - N-6-PUFA
    - N-3-PUFA
- Cholesterol

Source-based classification

- Animal-Based Fats: Typically higher in saturated fats and cholesterol; include dairy, meat, and fish oils.
- Plant-Based Fats: Rich in unsaturated fats; include seed oils, nut oils, and fruit oils.
- Processed Fats: Often contain harmful trans fats; include hydrogenated and refined oils.
    - Industrial trans fats (iTFA)
- Marine-Based Fats: Excellent sources of omega-3 fatty acids; include fish and algal oils.

Ruminant trans fats (rTFA)- naturally occurring fatty acids that are synthesized via bacterial metabolism of unsaturated fatty acids in ruminant animals and found in ruminant--derived foods [12].

There are 2 predominant sources of dietary *trans* fatty acids (TFA) in the food supply, those formed during the industrial partial hydrogenation of vegetable oils (iTFA) and those formed by biohydrogenation in ruminants (rTFA), including vaccenic acid (VA) and the naturally occurring isomer of conjugated linoleic acid, *cis*-9, *trans*-11 CLA (c9,t11-CLA) [12].

The role of fats in human health

1. Energy Provision:

   Fats are the most energy-dense macronutrient, providing 9 calories per gram (compared to 4 calories per gram for carbohydrates and proteins). They serve as a long-term energy reserve, stored in adipose tissue and mobilized during periods of fasting, exercise, or caloric deficit.

2. Nutrient Absorption:

   Fats are essential for the absorption of fat-soluble vitamins (A, D, E, and K) and carotenoids (e.g., beta-carotene). Without adequate dietary fat, the body cannot effectively absorb and utilize these nutrients, leading to potential deficiencies.

3. Cell Structure and Function:

   Fats are integral components of cell membranes, providing structure, fluidity, and flexibility. They play a role in cell signaling and communication, influencing processes like inflammation, immunity, and hormone regulation.

4. Brain Health and Cognitive Function:

   The brain is composed of nearly 60% fat, and dietary fats are crucial for its development and function.

   Omega-3 fatty acids (e.g., DHA and EPA) are particularly important for:

   - Cognitive performance and memory.
   - Mood regulation and mental health (e.g., reducing symptoms of depression and anxiety).
   - Neuroprotection and reducing the risk of neurodegenerative diseases (e.g., Alzheimer's).

5. Hormone Production:

   Adequate fat intake is essential for maintaining hormonal balance and supporting reproductive health.

   Fats are precursors for the synthesis of steroid hormones, including:

   - Sex hormones (e.g., estrogen, testosterone). Stress hormones (e.g., cortisol).
   - Vitamin D

6. Inflammation and Immune Function:

   Omega-3 fatty acids have potent anti-inflammatory properties, helping to reduce chronic inflammation linked to diseases like arthritis, heart disease, and diabetes.

   Omega-6 fatty acids are involved in pro-inflammatory responses, which are necessary for immune defense and tissue repair.

   A balanced intake of omega-3 and omega-6 fats is crucial for regulating inflammation and supporting immune health.

7. Cardiovascular Health:

   Unsaturated fats (monounsaturated and polyunsaturated) improve heart health by:

   - Lowering LDL cholesterol ("bad" cholesterol).
   - Increasing HDL cholesterol ("good" cholesterol).
   - Reducing triglycerides and blood pressure.

   Omega-3 fatty acids are particularly beneficial for preventing arrhythmias, reducing plaque buildup in arteries, and lowering the risk of heart attacks and strokes.

8. Thermal Insulation and Organ Protection:

   Fats provide insulation to help maintain body temperature. They act as a protective cushion for vital organs (e.g., kidneys, liver), shielding them from physical impact and injury.

9. Satiety and Appetite Regulation:

   Fats play an important role in psychological aspects of eating, because they contribute to the palatability and texture of foods, making meals more enjoyable. They promote satiety (feeling full) by slowing digestion, which helps regulate appetite and prevent overeating.

10. Skin and Hair Health:

    Fats are essential for maintaining healthy skin and hair by:

    - Supporting the skin's lipid barrier, which retains moisture and protects against environmental damage.

- Providing essential fatty acids that reduce dryness, inflammation, and conditions like eczema.

11. Metabolic Health:

    Fats play a role in insulin sensitivity and glucose metabolism. Medium-chain triglycerides (MCTs) are rapidly metabolized and may support weight management and energy production, particularly in ketogenic diets.

Historical Perspective on Fat Consumption and Evolving Dietary Guidelines:

The perception of dietary fats has undergone significant changes over the past century. In the early 20th century, fats were valued as a dense energy source, essential for survival, especially during times of food scarcity. However, by the mid-20th century, concerns about heart disease led to a shift in dietary guidelines.

The 1950s-1970s saw the rise of the "lipid hypothesis," which linked saturated fats and cholesterol to cardiovascular disease. Fatty acids and plasma cholesterol: the total concentration of plasma cholesterol (total-C) was one of the earliest risk factors identified for CHD and formed the basis of the lipid hypothesis, which is that reducing total-C would be expected to lower the risk of CHD [6]. This prompted recommendations to reduce total fat intake, particularly saturated fats, and increase carbohydrate consumption. Several metabolic studies beginning in the 1950s identified SFA and n-6 PUFA as major dietary influences of total-C [7]. This led to the development of the diet heart hypothesis, that decreasing SFA and/or increasing n-6 PUFA would be expected to lower the risk of CHD [8].

The 1980s and 1990s marked the era of low-fat diets, with many processed low-fat products flooding the market. However, this approach often led to increased sugar consumption and unintended health consequences, such as rising obesity rates. By the early 2000s, research began to highlight the benefits of unsaturated fats, particularly omega-3 fatty acids, and the dangers of trans fats.

More recent evidence has identified the total-C: HDL-C ratio as being the measure of plasma cholesterol that is most predictive of CHD and is twice as predictive as total-C [9]. Therefore, the original lipid hypothesis and diet heart hypothesis should be modified to make predictions based on the total-C: HDL-C ratio, rather than total-C. When compared to carbohydrates, SFA does not significantly affect the total-C: HDL-C ratio as it raises both LDL-C and HDL-C, a point that is often ignored [10], although replacing SFA with either MUFA or PUFA would still lower the total-C: HDL-C ratio [11].

Today, dietary guidelines emphasize the quality of fats rather than quantity, promoting the consumption of unsaturated fats (e.g., olive oil, nuts, fish) while limiting saturated and trans fats. The focus has shifted to balanced, whole-food diets, reflecting a deeper understanding of fats' complex roles in health and disease. This evolution underscores the importance of evidence-based nutrition and the need to adapt guidelines as scientific knowledge advances.

A cornerstone of conventional dietary advice is the recommendation to reduce the intake of saturated fatty acids (SFA) to reduce the risk of coronary heart disease (CHD). There are a few variations of this recommendation, these include:

1) advice to reduce the intake of SFA;

2) advice to replace SFA with monounsaturated fatty acids (MUFA) and mostly n-6 polyunsaturated fatty acids (PUFA);

3) advice to replace SFA with mostly n-6 PUFA.

Altogether, it is perhaps the single most influential recommendation in conventional dietary advice. It provides the basis to recommend low-fat dairy and lean meats over full-fat dairy and fattier cuts of meat; to recommend margarine and vegetable oils instead of butter and animal fats; and may lead to a greater emphasis on plant foods over animal foods. However, the evidence underlying this recommendation has been questioned by recent meta-analyses of observational studies and clinical trials.[2]

The negative perception of dairy fats stems from the effort to reduce dietary saturated fatty acid (SFA) intake due to their association with increased cholesterol levels upon consumption and the increased risk of CVD development. Institutions that set dietary guidelines have approached dairy products with negative bias and used poor scientific data in the past. As a result, the consumption of dairy products was considered detrimental to our cardiovascular health.[3]

The role of limited social awareness of types and effects of different kinds of fatty acids

The way consumers obtain nutrition information has changed substantially in the past two decades. Use of the internet and social media has grown rapidly, and these are now among the leading sources of information for health and wellness. Perhaps due to access to more information than ever, including conflicting information of uncertain and variable quality, many consumers are more confused than ever. Consumers are often confused about nutrition research findings and recommendations [14].

Within the nutrition community, one example of suboptimal communication between scientists and the public is the continued demonization and general avoidance of dietary fat.

Within the nutrition community, one example of suboptimal communication between scientists and the public is the continued demonization and general avoidance of dietary fat

Studies assessed knowledge of people with T2DM and reported poor nutrition knowledge regarding the health effect of fat consumption. Two opposing attitudes towards dietary fat was reported:

1) dietary fat should be limited,

2) promoted dietary fat intake through a low-carbohydrate diet.

Participants reported behaviors of limiting fat intake, including trimming visible fat or choosing lower-fat alternatives. Total fat intake ranged between 10 and 66% of participants' total energy intake, while saturated fat intake ranged between 10 and 17%. People with T2DM reported poor knowledge of dietary fats in particular, and they were frequently unable to identify high-fat food. Attitudes towards dietary fat were heterogeneous, and regarding behaviors, saturated fat intake was higher than recommended. Future studies should assess the KAB of people with T2DM based on dietary fat subtypes.[5]

Current fats intake recommendations

Quantitative range intake recommendations for daily total fat intake included boundaries from **20** to **35%** of total energy intake (TEI), for monounsaturated fat (MUFA) 10–25%, for polyunsaturated fat (PUFA) 6–11%, for saturated-fat (SFA) ≤11–≤7%, for industrial trans-fat (TFA) ≤2–0%, and <300–<200 mg/d for dietary cholesterol [13].

Conclusions:

1) Saturated fats are not associated with all cause mortality, CVD, CHD, ischemic stroke, or type 2 diabetes, but the evidence is heterogeneous with methodological limitations.
2) Trans fats are associated with all cause mortality, total CHD, and CHD mortality, probably because of higher levels of intake of industrial trans fats than ruminant trans fats. Dietary guidelines must carefully consider the health effects of recommendations for alternative macronutrients to replace trans fats and saturated fats.[4]
3) Although the methodological approaches of the dietary guidelines were heterogeneous, most of them recommend total fat intakes of 30-≤35% of TEI, replacement of SFA with PUFA and MUFA, and avoidance of industrial TFA [13].

Cardiovascular diseases

Available evidence from adequately controlled randomized controlled trials suggests replacing SFA with mostly n-6 PUFA is unlikely to reduce CHD events, CHD mortality, or total mortality. The suggestion of benefits reported in earlier meta-analyses is due to the inclusion of

inadequately controlled trials. These findings have implications for current dietary recommendations.[2]

Disclosures

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