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Bringing some balance to fat bashing

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Fats and oils are essential to human nutrition, yet often vilified in public discourse and dietary guidelines. We challenge the narrative that all dietary fats are inherently harmful and explore the vital roles fats play in health and food security. We review evidence on saturated, unsaturated, and trans fats, highlighting meta-analyses that question the links between saturated fat and health. We examine global disparities in fat access, shortcomings in current guidance, and the broader environmental and social impacts of fat sources. No crop is inherently good or bad, what matters is how, where, and by whom it is produced. We call for broad collaborations to produce more nuanced, evidence-based recommendations that reflect cultural traditions, sustainability, and the twin burdens of obesity and undernutrition.

KEYWORDS

cardiovascular health, dietary guidelines, environmental sustainability, fat gap, nutritional science, saturated fatty acids, trans fatty acids, vegetable oils

1 Introduction

This essay aims to reframe the debate on fats by examining both their role in nutrition and the oversimplifications that surrounds them in public messaging. Fats have long been demonized. In many cultures, consumers have been convinced to avoid various fats because of their alleged negative health effects (Snape, 2025) or their production impacts on the environment (Meijaard et al., 2022). Lipids—fats and oils—make foods appealing by contributing to their texture, flavour, and aroma. They are natural components of many foods including meat, fish, dairy products, and nuts, and are also added to many during preparation, processing or cooking.

Fats are also concentrated sources of energy. But in a modern world where obesity is rampant, dietary guidance to avoid fats can be justified by fats containing 2.5 times more calories per gram than proteins or carbohydrates (Eichorn and Evert, 2013). If calories are the enemy, reducing the intake of fat, our most energy-dense nutrient, seems logical.

We organise our essay as follows. We first examine the scientific and historical basis for concerns about dietary fats. Next, we explore the nutritional and functional roles of different fat types. We then address innovations like fat replacers, the global challenge of fat access (the "fat gap"), and finally the broader public debates surrounding vegetable oils and their environmental and social impacts. We propose a more nuanced view of these complex issues based on interdisciplinary collaboration, funding of long-term comparative studies, and development of standardized assessment methods for both health and other outcomes.

1.1 Understanding dietary fats: history and health implications

To understand current debates about dietary fats, we review the historical foundations of dietary guidelines and explore the health effects of various fat types, especially saturated and trans fats (for descriptions see next section), and how the guidelines evolved over the past decades. Since the 1950s, the risk of developing cardiovascular disease has been linked to intake of foods high in saturated fatty acids, leading to limits on saturated fat intake in dietary guidance (Lawrence, 2021). Initially, guidance focused on limiting animal fats, but it was later found that certain plant oils, including coconut and oil palm, were also rich in saturated fatty acids. These plant-derived saturated fats differ from those derived from animals in that they comprise shorter fatty acids which unlike the longer animal fatty acids have not been clearly linked to increased "serum cholesterol"— a proxy measure based on blood lipoproteins rather than actual cholesterol—a biomarker linked to increased risk of cardiovascular disease (Praagman et al., 2019; Perna and Hewlings, 2022).

While nutrition research remains challenging to conduct (Hall, 2020) there does appear to be genuine if uneven progress. Public health guidelines appear increasingly specific about the types of fats to avoid, limit (trans-fats and some saturated fats) or encourage (unsaturated fats, especially omega-3 polyunsaturated fatty acids) (Talukdar et al., 2023). Also, a recent overview of systematic reviews using Grading of Recommendations, Assessment, Development, and Evaluations (GRADE) found that studies on saturated fat and mortality, cancer or cardiometabolic outcomes almost universally suggest small risk differences, based largely on "low to very low certainty evidence" (Talukdar et al., 2023). These findings show uncertainty around the degree to which health outcomes can benefit from reduced intake of saturated fatty acids (Dehghan et al., 2017; Astrup et al., 2021; Lawrence, 2021; Waehler, 2023). They also raise questions about the validity of guidelines that promote reducing saturated fatty acid intake for everyone (World Health Organization, 2023).

1.2 Functional roles and health effects of fats

Dietary guidelines change as knowledge evolves. In recent decades the changes around dietary fats have been sufficiently marked to raise questions as to the value of such guidelines, and if they are liable to change yet again. In parallel, consumers may become frustrated by changing concerns and guidelines requiring they move from one set of commodities to others and back (Harvard Health Publishing, 2018; Bihola et al., 2025; Haile et al., 2025). So where are we now?

We eat foods, not isolated nutrients. These foods determine the fats and fat-soluble compounds we ingest and absorb. The fat-soluble vitamins (A, D, E, and K) require dietary fat for absorption and transport. These vitamins have diverse functions, including vision (vitamin A), bone health and calcium homeostasis (vitamin D), antioxidant defence (vitamin E), and blood clotting (vitamin K). Deficiencies in these vitamins can lead to a range of health problems.

Dietary fats are commonly categorized into three main types—saturated fats, monounsaturated fatty acids, and polyunsaturated fatty acids—with the last type further divided into omega-3 and omega-6. Each fat type differs in structure, biological function, and apparent health implications, requiring separate consideration.

1.2.1 Saturated fats

Saturated fats are valued in certain food applications such as baked goods due to their solidity at room temperature which helps create structure and texture. They contribute to the desirable mouthfeel, stability, and flakiness in products like pastries and cookies/biscuits. Additionally, saturated fats are chemically more stable and are less prone to oxidation than unsaturated fats, which improves shelf life and flavour stability in baked products.

Saturated fats have a long history of being linked to elevated cardiovascular risk. This association has, however, been questioned recently. Prospective cohort studies which include data from 18 countries on five continents found that higher carbohydrate intake was associated with an increased risk of total mortality, whereas total fat and individual types of fat were related to lower total mortality (Dehghan et al., 2017). Neither total fat nor types of fat were associated with cardiovascular disease, myocardial infarction, or cardiovascular disease mortality, while saturated fat had an inverse association with stroke. The authors propose that global dietary guidelines should be reconsidered in light of these findings.

Other recent analyses suggest that the effects of saturated fats depend on dietary context, food source, and nutrient replacement patterns (Sacks et al., 2017). Dietary guidance has shifted to promoting whole foods, rather than the removal of saturated fats. Whole food research has found that whole-fat dairy, meats, and dark chocolate are rich in saturated fats in a complex matrix, but contrary to expectations, intake of these foods are not linked to increased risk of cardiovascular disease (Astrup et al., 2020; Lamarche et al., 2025). Lamarche et al. (2025) summarized the data presented and discussions held within a panel of international nutrition research experts at a high-level workshop in 2024 on "Saturated Fat in Dairy and Cardiovascular Diseases." They suggested that strategies that focus primarily on reduction of energy-dense, nutrient poor foods, the main source of saturated fats in Western diets rather than limiting consumption of foods high in saturated fats, will yield better health outcomes. Recent meta-analyses of observational and clinical studies cast doubt on the validity of the low-fat dietary recommendations for all. When saturated fats are removed from the diet, they are generally replaced by high glycemic-load carbohydrates, which has been linked to an increase in the prevalence of obesity and type-2 diabetes (Grasgruber, 2025).

1.2.2 Unsaturated fats

Unsaturated fats vary in the length of the carbon chains in the constituent fatty acids and in the number of double bonds. These differences influence their physical properties and biological functions. Monounsaturated fats have one double bond, are abundant in plant sources such as olive, sesame, groundnut and rapeseed, and have been linked to anti-inflammatory effects (Schwingshackl and Hoffmann, 2012). Polyunsaturated fats, including essential fatty acids (EFAs), have two or more double bonds, cannot be synthesized by the human body and must be obtained through diet. They are essential in cellular membrane structure and function, eicosanoid (signalling molecule) biosynthesis, and gene regulation. Examples include alpha-linolenic acid and docosahexaenoic acid which function in vision, brain development, and immune responses. Omega-3 polyunsaturated fatty acids (PUFA)—notably eicosapentaenoic acid and docosahexaenoic acid from fish—appear to exert beneficial anti-inflammatory effects (Calder, 2017). In contrast, omega-6 polyunsaturated fatty acids, such as linoleic acid from vegetable oils, are essential for cellular function but can contribute to pro-inflammatory pathways when consumed in excess relative to omega-3s, a common imbalance in Western dietary patterns (Simopoulos, 2016).

We note that many studies on the health benefits of PUFA oils, such as soybean, maize and cottonseed, have been conducted using unheated oils. In practice, however, PUFA-rich oils are often exposed to high temperatures during cooking (>180°C), where they are prone to oxidative degradation. This generates a complex mixture of products, including potentially harmful trans-isomers, aldehydes, free radicals, and polymeric compounds (Grootveld, 2022; Abrante-Pascual et al., 2024). These products have potential adverse health effects, which are largely overlooked in dietary surveys and intervention studies. By contrast, saturated and monounsaturated oils show greater stability when used in cooking, an advantage that has received comparatively little attention in nutritional assessments (Moumtaz et al., 2019).

1.2.3 Trans-fats

One approach that manufacturers have used to replace, or generate, saturated fats has been to "hydrogenate" polyunsaturated fats, often from vegetable oils, to make them more saturated. The hydrogenation process can produce "trans-fatty acids" that may be more problematic than saturated fatty acids for links to systemic inflammation and cardiovascular disease (Mozaffarian et al., 2006; de Souza et al., 2015). A recent systematic review concluded that when trans-fatty acids account for approximately 0.25–2.56% of daily energy intake this leads to an increase in ischaemic heart disease risk of at least 3%, though the authors note the limited strength and consistency of the supporting evidence. The authors argue that while current evidence supports caution, further research is needed (Haile et al., 2025).

1.2.4 Genetically modified oil crops and other lipids

Another contentious issue is the production of oils using genetically modified crops and their health impact. Genetically modified crops are varieties of soybeans, rapeseed (canola), maize, and other vegetable oil crops that have been altered to introduce desired traits such as herbicide tolerance, pest resistance, or modified fatty acid composition. While strictly regulated in many countries—including most of Europe as well as many others, such as Algeria, Peru, Russia, Madagascar, Kyrgyzstan and Venezuela—they are widely grown in some countries, such as the USA, China, India, Argentina, South Africa, Malawi, Pakistan, Vietnam and Nigeria, because they can reduce production costs, improve yields, and provide oils with properties better suited to food processing. For example, genetically modified safflower, sunflower or rapeseed can create high-oleic oils that are more stable during frying and have longer shelf lives (Adjonu et al., 2025), or transgenic *Camelina sativa* ("false flax") can create essential PUFAs and replace fish oils (West et al., 2021).

Public concerns, however, focus on several issues: the potential environmental impacts of large-scale monocultures (including herbicide resistance and biodiversity loss), uncertainties about long-term human health effects, corporate control of seed markets, and the cultural or ethical unease some communities feel about genetic modification in food (Bawa and Anilakumar, 2013). There are also questions and concerns around transparency and willingness to trust technical corporations and the power imbalance they already wield in many regions, and whether countries have the knowledge needed to ensure adequate safeguards (Cummings et al., 2024; Buddle et al., 2025) These concerns mean that while GMO crops dominate in some regions where regulation has been low light (e.g., the Americas), they face resistance and regulatory hurdles in others, especially in Europe and parts of Asia.

Many questions remain about the health impacts of different fats and lipids and defining a healthy diet in this regard is a moving target. Some evidence suggests, for example, that previously overlooked odd-chain lipids may be essential (Venn-Watson et al., 2020; Venn-Watson, 2024). These differences may also help explain why processed foods are often linked to poorer health outcomes (Pagliai et al., 2021; Harlina et al., 2024). In this fog of uncertainty, the bold voices of self-appointed health gurus, or politicians (Snape, 2025), often drown out the cautious advice of experts. Nonetheless, knowledge remains uncertain and evolving and we need to weigh evidence and be ready to revise our judgements.

In conclusion, it is important to recognize that fats serve diverse and essential functions in our diets beyond just impacting serum cholesterol levels. Nevertheless, in response to perceived health concerns, a new class of ingredients—fat replacers—has been developed. We turn to these next.

1.3 Fat replacers and their limitations

Given the concerns surrounding saturated and trans-fats, alternatives that mimic fat's functions have been developed. These "fat replacers" are food ingredients intended to simulate the texture and mouthfeel of fats. They are used in "healthy" options to cut calories, potentially reduce production costs, and sometimes extend shelf life. Most comprise carbohydrate-based bulking agents (gums, fibres, starches) or protein-based products (such as whey). No one formulation can replicate all desirable fat related functions with many different approaches being used in fat-modified products.

While research suggests these fat replacers may sometimes modestly aid weight management, the long-term health effects of fat replacers remain unclear and are increasingly being questioned (Syan et al., 2024). These substitutes can alter satiety signals, appetite and nutrient absorption. Further investigation will be needed to determine their broader implications for health. Development of fat replacers and alternative oil production methods, has yet to be taken to a scale that competes with traditional sources of dietary fats (Parsons et al., 2020; Meijaard et al., 2024).

1.4 The global 'fat gap': undernutrition and obesity

A key global issue is unequal access to fats—ranging from scarcity to overconsumption—a disparity commonly referred to as the global "fat gap" (Bajželj et al., 2021). The double burden of underweight and obesity continues to be a major worldwide public health problem (Tumas and López, 2024). This finding extends to the important but often overlooked role of fats and oils in addressing hunger and malnutrition. An estimated 691 to 783 million people faced hunger and insufficient access to dietary energy in 2021 with much of this shortfall being related to fats (FAO, IFAD, UNICEF, WFP, and WHO, 2021). This "fat gap" has been estimated at 45 million tonnes of dietary fat per year globally (Bajželj et al., 2021), but may be smaller as subsistence-level oil production is often overlooked in global statistics (Descals et al., 2025). This gap primarily relates to sub-Saharan Africa, Southeast Asia, and South Asia and is projected to increase by 2050 to 88–139 million tonnes of oils and fats, unless people in these regions can more readily access affordable oils and fats. Although fats and oils often remain more affordable than other nutritious food groups, economic disparities still hinder access to overall healthy diets, with over 35% of the global population not being able to afford a healthy diet in 2022 (World Bank, 2024). Addressing the global fat gap requires increasing the supply of affordable, nutrient-rich oils through sustainable, locally appropriate production that generates income for impoverished people; integrating healthy fats into nutrition programs; and aligning policies across health, agriculture, and trade.

Obesity has long been seen as a problem that afflicts the wealthy, but the reality is more complex. The transition from underweight to obesity can occur rapidly, determined by early life nutrition, diet quality, food environments, and socioeconomic factors (Tumas and López, 2024), and fats play an important role in this transition. So, while closing the fat gap is one objective, avoiding obesity is another. Especially oils and fat from vegetable rather than animal sources are important because in developing countries the former make the biggest contribution to the per capita supply per day (FAO, 2008).

1.5 Vegetable oils, sustainability, and public debate

Finally, we turn to the contentious debate over vegetable oils, addressing how health, culture, and sustainability intersect in oil crop production and consumption. This debate exemplifies the broader challenge: finding a balance between promoting health, respecting cultural traditions, and ensuring environmental and social sustainability and good practice. We recently published a review on the future of vegetable oils and the implications for people and nature (Meijaard et al., 2024). We find that there have been influential discussions around the impacts of certain crops—notably oil palm—that are seen as having caused severe loss of high biodiversity habitats. These have led to consumers in some regions seeking to boycott these ingredients and in companies advertising their efforts to avoid them (Mackay, 2019). But we find that reality is more complex. While there have been major problems that justify concerns, a boycott of selected crops is unlikely to be beneficial (Meijaard et al., 2020b; Chiriacò et al., 2025).

For every vegetable oil crop we reviewed we found examples of negative environmental and social impacts, and it seems that these impacts are associated with production and trade systems and practices rather than with the crops as such. For example, there are large areas of monoculture oil palm that have replaced tropical rainforest and displaced indigenous people, but there are also large areas of subsistence and smallholder oil palm with limited environmental impact and vital roles in food security —the same crop but distinct production, trade and consumption contexts and impacts. Thus, despite strong societal views on the impacts of different oil crops, there are no inherently good or bad oil crops, but only good and bad ways of producing them. We should not hold the crop accountable but the producers and their methods of production.

The real question is not which oil is "worst" or "best"—whatever that may mean—but who profits, who loses, and how this is determined. The public debate on these oils seems to be strongly influenced by assumptions that are poorly supported by science, and often data are completely lacking (Candellone et al., 2024; Meijaard et al., 2025). For example, while the practices that permit human rights abuses in palm oil production are often mentioned in social media, those that may be associated with similar practices in the production of other crops such as sesame oil (Soliman, 2023; ETI Sweden, 2023) remain largely unknown. This selective scrutiny on certain crops distorts views on relative impacts. The resulting biases increase when available data and assessments lack objectivity. Much of the information on vegetable oil sustainability and impact comes from authors with interests in either promoting or opposing particular crops (Meijaard et al., 2020a), and the influence of these biases is seldom transparent. Often, In some cases, specific concerns or preferences appear to shape how other impacts—positive or negative—are presented. This makes it hard for consumers to evaluate such studies and makes claims suspect.

Overcoming selective vision and distorted views requires sharing and integrating good data from across disciplines including nutrition, food science, agronomy, conservation, economic development, business development, public health, and dietary guidance that helps respect local cultures and economies. Different regions and cultures have different relationships with food oils. It is hard to imagine a Mediterranean cuisine without olive oil or a west African cuisine without red, unrefined palm oil. Nonetheless, in a world in which it is often cheaper to produce vegetable oil in one region and transport them to another, the impacts of these choices and preferences are increasingly globalised and interlinked.

Thus, distorted views also extend to cultural and economic dimensions. Traditional fats such as red palm oil and coconut oil are integral to cuisines and food practices, and a range of other uses (e.g., medicine, cosmetics, food for human and animal consumption, lubrication, lighting) that have sustained societies for millennia (Way and Okie, 2019), yet modern dietary guidelines often label them as unhealthy while promoting industrially produced oils as healthier alternatives. This framing risks eroding cultural food traditions and promoting convergence toward Western dietary patterns (Way and Okie, 2019). There are also various less-well-known but locally important oil crops that are often not considered at all. Examples include fat derived from several species of wild and semi-wild *Allanblackia* spp. trees in humid Africa and the oil-rich fruits of the Macauba palm (*Acrocomia aculeata*) long used by people in parts of Mexico and the similarly used Pijuayo palm (*Bactris gasipaes*) widely consumed in parts of the Amazon. There is a danger that the production and availability of cheap food oils will replace much of this diversity and associated culture (Stuckler and Nestle, 2012). Such links have been shown to bias both the interpretation of evidence and the direction of nutrition research (Lesser et al., 2007). As a result, western dietary guidelines have often favoured modern seed oils, while overlooking the cultural and nutritional value of traditional fats. This dynamic is at the root of much of the fat bashing that has characterized nutrition debates, but also in the reformulation of product ingredients to shift attention away from fats (Scrinis, 2016).

Assessment of "sustainability" in vegetable oil value chains requires that we weigh up the impact of a wide range of social, environmental, cultural and economic impacts, while these relationships remain highly nuanced and complex (Gaitán-Cremaschi et al., 2018; Janker and Mann, 2020). Getting the future of vegetable oils "right," or at least averting and avoiding the least desirable potential futures, is however of crucial importance. Oil crops use 37% of global crop land and are the fastest growing commodity (Meijaard et al., 2024). What we do with this land and its potential expansion to meet future production and consumption needs has major social and environmental implications. For example, the EAT-Lancet Report proposed the Planetary Health Diet—guidelines aimed at feeding a growing global population as far as possible within the planetary boundaries required for people to safely thrive (Willett et al., 2019). Among these recommendations, the diet outlines specific targets for daily oil consumption: 6.8 g of saturated fats and 40 g of unsaturated fats. Following these dietary recommendations under a growing human population, however, implies major negative impacts on wildlife habitats and climate change, especially if low efficiency crops such as soybean, rapeseed and sunflower are preferred over oil palm (Chiriacò et al., 2025). These trade-offs between health and environmental outcomes need to be resolved, but also their assumptions—such as the links between fat types and health—need to be re-evaluated. This presents a dilemma for policy makers attempting to align dietary guidance with sustainability goals.

Balancing crop production with land sparing and ecosystem protection—while respecting the needs, health, and preferences of local communities—remains challenging. Nonetheless, the identification of preferable approaches remains possible through cross-disciplinary collaboration and good science.

2 Discussion

Dietary fats have various associations and effects when we consider nutrition, health and a broad range of additional social and environmental concerns. Saturated fats' impact on cardiovascular health depends on their food source and dietary context, suggesting that blanket restrictions may overlook their functional and cultural roles. Monounsaturated and polyunsaturated fats—particularly omega-3 s—provide well-supported anti-inflammatory and cardiometabolic benefits, while omega-6 s require balance.

Current evidence suggests industrial trans-fats are harmful, and although novel fat replacers can reduce calories, their long-term safety and effects on satiety require further study. Globally, undernutrition and obesity coexist in a "fat gap," necessitating culturally appropriate strategies to ensure both adequate access and healthy transitions. Finally, no single oil crop is universally "good" or "bad," so responsible production practices that honour ecosystems and local traditions must underpin any health-focused recommendations as well as choices reflecting broader concerns.

To reconcile differing perspectives on fats, public health, and environmental and social impacts, we should foster and incentivize interdisciplinary collaboration, fund long-term comparative studies, and develop and apply standardized assessment methods—such as using GRADE to evaluate health impacts of dietary fats, and lifecycle assessment or land-use efficiency metrics to compare environmental and social outcomes across different vegetable oil crops and value chains.

In line with the goal of the current special issue on Plant-Based Lipids for Sustainable Food Products, we call for the further improvement of vegetable oil production systems to meet growing demand for healthy and nutritious food from plant-based products while also respecting other goals and constraints. This requires integrating policy initiatives—such as the EAT-Lancet Planetary Health Diet—with community engagement approaches that respect traditional practices (such as the use of red palm oil in West African cuisine), and leveraging data analytics and emerging technologies—like geospatial monitoring of oil crop expansion or social media analysis to track public perceptions—to provide real-time insights that can inform balanced, evidence-based dietary and agricultural guidelines.

Ultimately, progress depends more on collaboration than conflict. Bridging divides—between Big Food and Big Public Health, producers and consumers—requires less confident assertion and more shared understanding of uncertainties and goals. Production systems must support diets that are not only nutritionally adequate, but also culturally relevant, locally appropriate, and environmentally responsible. Undernourished people need calories, but how those calories are delivered matters too. We need robust, transparent science on how dietary fats affect diverse populations, and these findings must be weighed against the broader social, ecological, and economic impacts of fat production. Beyond nutrition and food security, the key issue is not the crop itself, but how, where, and by whom it is produced. Better outcomes demand good evidence and cooperation.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

JS: Conceptualization, Writing – original draft, Writing – review & editing. EM: Conceptualization, Funding acquisition, Supervision, Writing – original draft, Writing – review & editing. DS: Conceptualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

JS and EM were independent members of the Sustainable Nutrition Scientific Board. EM and DS were members of the IUCN Oil Crops Task Force. DS and EM have facilitated student research on palm oil and soybean. JS serves on the Scientific Advisory Boards for Simply Good Foods, Olipop, and Kenvue. JS owns and manages the Slavin Sisters Farm LLC, and is a scientific advisor for the Institute for the Advancement of Food and Nutrition Sciences (IAFNS).

Generative AI statement

The authors declare that Gen AI was used in the creation of this manuscript. We used ChatGTP-O3-mini-high to check logical flow and redundancy in earlier versions of this essay.

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