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How the U.S. Low-Fat Diet Recommendations of 1977 Contributed to the Declining Health of Americans

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*How the U.S. Low-Fat Diet
Recommendations of 1977 Contributed to
the Declining Health of Americans*

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Introduction

In 1977, the first edition of *The Dietary Goals for the United States* was published in attempts to reduce incidence of diet-related diseases such as cardiovascular disease and diabetes. While numerous dietary adjustments were recommended in order to improve health, fat was identified as the most instrumental factor. While they were well-intended, the US low-fat guidelines made in 1977 caused an overhaul of both the food industry and the average American's perception of a healthy diet, eventually contributing to an overall decline in health, specifically an increased national obesity rate and incidence of related diseases, rather than the anticipated opposite result.

Prior to The Recommendations

Food Culture in the Early 20th Century

Leading up to the 1970s, the United States' food industry was rapidly transforming. In the earlier half of the 20th century, packaged foods were just beginning to become available nation-wide. But The Great Depression kept any industry from booming, and therefore home-raised and grown food was common (1). World War II brought the industrial prosperity the country so needed, but it forced the US into a time of rationing. Canned and packaged goods were largely sent overseas to soldiers rather than entering domestic homes (1). However, propaganda during this period promised Americans that, once the war was won, they'd be able to enjoy plentiful food. And having what you wanted was the American way. The '50s delivered on this promise.

With the end of the war came a boom of both economic and population growth. America's GDP grew by more than 400% between 1940 and 1960 (2). Industry expanded and

became more efficient. People started moving out of the overcrowded cities and into the suburban areas around them, as the freestanding home with a green yard and white picket fence became the American dream. Cars became more affordable, drastically minimizing physical activity done by the average working class citizen (2). People became even more sedentary when the TV became affordable for middle class homes, birthing the popularity of the TV dinner. People were also therefore exposed to more and more advertising of the overly processed foods that were being manufactured at increased rates (2). People were moving away from the concept that they should only be buying things they *needed* and were becoming more familiar with the ability to buy what they *wanted*, providing the advertising business with plenty of opportunity to sway consumers to purchase their products. Images of calorie-rich but nutritionally void foods like M&Ms, Coca-Cola and Oreos were constantly being broadcasted into the homes of middle class Americans with money, but not necessarily time, to spare. The desire for the familiar flavors of these foods grew.

Labor saving technologies of the '50s, which allowed food to be mass-produced and prepared in a centralized location, heavily contributed to the expansion of not only shelf-stable processed foods, but also fast food restaurants. The McDonald brothers opened their first barbeque restaurant complete with carhops and a 35-item menu in the '40s. In the '50s, they changed their business model to feature a more hamburger-centric menu and a kitchen assembly line known as "Speedee Service" to cater towards the developing mentality of customers to get in and out as fast as possible (3). McDonald's began franchising in the mid '50s, and quickly expanded into the conglomerate we know today. Modeled after the success of McDonald's, Burger King first opened its doors in 1954 (3). A burger and fries quickly became the quintessential American meal. There were also non-hamburger contributors to the movement,

like Kentucky Fried Chicken and Pizza Hut, which opened in 1952 and 1958, respectively (3). Denny's, which first opened in 1959 and became the first full-serve family restaurant chain, combined the concept of fast and standardized food with that of eating a meal around a table with family (4).

The following decades only perpetuated what the '50s had begun. Wendy's Hamburgers opened in 1969. Domino's Pizza began using the method of delivery to get their pizzas into homes, reducing the already minimal work that Americans had to exert to get a hot meal from driving to the establishment to merely picking up the phone (5). Grocery store shelves were also taken to a new level with the introduction of aluminum cans, which allowed even the produce industry to hop on the shelf-stable bandwagon. The '70s and '80s introduced the foods and restaurants that are largely what we see today. McDonald's introduced its first drive thru window. And by 1975, nearly half of all working-age American women had entered the workforce (5), putting cheap and easy yet satisfying meals at the top of many to-do lists. But it became clear to health professionals that Americans were beginning to sacrifice their well being for these new saturated fat-rich foods and convenience-oriented eating patterns.

Scientific Advancements and Discoveries

Prior to 1977, many studies supporting the lowering of dietary fat intake had emerged from the scientific community. In 1950, scientists at the University of California, Berkeley published findings of blood lipoproteins, sized 5-8 and 10-20 Svedberg units (Sf), revealed via ultra-centrifugation of rabbit serum. These particles have since been identified as HDL and LDL cholesterol, respectively. Since the 10-20 Sf sized particles were then found in the serum of 100 of 104 human subjects with atherosclerosis, it was concluded that the two were likely directly related, sparking the nutrition field's interest on serum cholesterol's role in coronary heart

disease (CHD) and mortality (6). In 1953, researcher Ancel Keys published a review article stating that while dietary surveys failed to find an explicit connection between dietary cholesterol and serum cholesterol, controlled human studies repeatedly showed that total dietary fat, both animal- and plant-based, showed a direct link on blood cholesterol levels and CHD mortality (7). Keys then cited the statistically significant discrepancies in incidence and mortality of ‘all circulatory diseases’ and ‘degenerative heart diseases’ (including myocardial diseases and CHD) between the United States and other nations as the driving force behind his Seven Countries Study (SCS), piloted in 1958. Keys and his colleagues hypothesized that CHD was directly related to fat composition in the diet and to serum cholesterol levels (8). Follow up data compiled in 1970 suggested a strong cross-cultural link between dietary saturated fat, plasma cholesterol levels and CHD mortality rates (8). They concluded that the associations between saturated fat intake and serum cholesterol level and CHD incidence were causal (8). The size of the cohort and the wide time frame during which data were collected were compelling parameters; they helped to convince nutrition professionals that the conclusions drawn were scientifically sound.

During the same years SCS was underway, domestic strides against excessive dietary fat was beginning. In 1961, The Central Committee for Medical and Community Program of the American Heart Association (AHA) published a report regarding dietary fat and its relation to heart attack and stroke risk. The AHA suggested that the decrease of dietary cholesterol was important regarding heart disease development, but also warned Americans that it was not the sole factor. The report suggested that if dietary cholesterol intake was reduced but total daily calories were maintained, serum cholesterol would then be synthesized from other dietary constituents, specifically other types of fat (9). The report therefore went on to advise Americans

to decrease their total fat intake, as lipids contain 9 kcal per gram as compared to the 4 kcal per gram from carbohydrates or protein. This change would consequently help avoid obesity. The AHA recommended fat intake be limited to 25-35% of total daily calories and that saturated fats be replaced with shortenings, margarines and vegetable oils which had less than half as much saturated fat (9). Multiple studies published in the '70s also implicated dietary fat in carcinogenesis. In 1971, researchers from University of Western Ontario found that dietary fat content, but not necessarily the saturation degree, was positively associated with mammary adenocarcinomas in female Sprague-Dawley rats (10). Similar findings were observed in a study published out of the Naylor Dana Institute for Disease Prevention in early 1976; it found that total dietary fat amount, rather than type, was positively associated with colonic tumor incidence in rats (11).

The United States Senate Select Committee on Nutrition and Human Needs

In 1968, a CBS Documentary titled *Hunger In America* was broadcasted with the intent to display widespread malnutrition and related diseases across the country. In response to the film, as well as a publication titled *Hunger USA*, which brought to light the domestic existence of severe malnutrition diseases, senator George McGovern formed the United States Senate Select Committee on Nutrition and Human Needs ("the committee"). Although the committee's initial intentions were to combat poverty and hunger, its purpose slowly transitioned to overall nutritive health of Americans as overnutrition increasingly became a problem as well. In 1973, the committee helped get fat and cholesterol content onto food product labels. While this was considered to be a step in the right direction regarding nutrition education's role in health, the committee maintained that Americans needed explicit advice on what and what not to eat to optimize their health (12). Beginning in July 1976, the committee held hearings, titled *Diet*

Related to Killer Diseases, to provide a forum at which senators could hear from leading scientists regarding dietary influence on heart disease, cancer and other chronic diseases (12). It was from the information discussed at these hearings that the first edition of *Dietary Goals for the United States* (“The Recommendations”) was published in January 1977, which were as follows:

1. Increase carbohydrate consumption to account for 55 to 60 percent of the energy (caloric) intake.
2. Reduce overall fat consumption from approximately 40 to 30 percent energy intake.
3. Reduce saturated fat consumption to account for about 10 percent of total energy intake; and balance that with poly-unsaturated and mono-unsaturated fats, which should account for about 10 percent energy each.
4. Reduce cholesterol consumption to about 300mg a day.
5. Reduce sugar consumption by about 40 percent to account for about 15 percent of total energy intake
6. Reduce salt consumption by about 50 to 85 percent to approximately 3 grams a day.

The committee then went on to suggest specific changes in food selection and preparation to achieve these dietary goals:

1. Increase consumption of fruits and vegetables and whole grains.
2. Decrease consumption of meat and increase consumption of poultry and fish.
3. Decrease consumption of foods high in fat and partially substitute poly-unsaturated fat for saturated fat.
4. Substitute non-fat for whole milk.
5. Decrease consumption of butterfat, eggs and other high cholesterol sources.
6. Decrease consumption of sugar and foods high in sugar content.
7. Decrease consumption of salt and foods high in salt content.

In the forward of *The Recommendations*, the committee’s contributing members outlined why they felt there had become a need for dietary guidelines. McGovern noted it was the committee’s duty to recognize that the public was confused about what to eat in order to maximize health (13). Charles Percy added that both the government and the food industry had to be on board with *The Recommendations* to ensure their adherence. Otherwise, Americans would continue down their trajectory towards poor health (13). Many leading epidemiologists

and cardiologists were supporters of the guidelines. However the food industry was largely not ready to make the same commitment. David Stroud, president of the National Live Stock and Meat Board, called for a meeting between the Board and the committee to discuss key points of the guidelines and the science behind them (12). After the gathering, *Meat Board Reports* published an article stating, “[the committee] have not gained majority expert opinion. They have listened only to the clique of promoters holding this point of view, whose motives are questionable” (12). McGovern was eventually advised to issue a prepared statement in the interest of the meat industry, during which he stated the report did not explicitly state that meat consumption caused disease, and then went on to say he considered beef to be an excellent source of protein (12). In September 1977, McGovern conceded, against the advice of many committee members and professionals in the nutrition field, to the meat industry and issued a revision to the guidelines, which were printed that December. The amended version changed the recommendation to decrease meat consumption to “decrease consumption of animal fat, and choose meats [...] which will reduce saturated fat intake.” The revision of the guidelines harped on the negative effects of dietary constituents, namely total fat and saturated fat, rather than the food products containing them. The meat industry had done its best to protect its own interests, and American doctors began advising dietary alterations per the new recommendations.

The committee hoped The Recommendations would alleviate prevalence of all diet-related deaths, including those caused by cancer, obesity, and stroke. However, heart disease-related deaths and their link to dietary fat emerged as the main focus. The next two decades were indicative of The Recommendations’ success in changing dietary fat intake nationwide; total fat intake decreased 41% from 1980 to 1997 (14). At the time of publication, ‘diseases of heart,’ (which does not include stroke), was far and away the number one killer of Americans; its crude

death rate had been climbing since it overtook tuberculosis and pneumonia as the most lethal disease in 1910 (15). Heart disease still remains the top cause of American deaths, but its crude death rate has experienced a recent plateau and drop, beginning around the time of The Recommendations (16). However, while these statistics are compelling, it would be naïve to assume that this change can be attributed to one, isolated dietary constituent. Somehow, a change did occur, and this change did lessen the incidence of CVD, the committee's top priority. But fat cannot be considered as a stand-alone entity, simply because it does not exist as such in any diet. It is only one of many bioactive components in any single food item; Foods are more than just the sum of their parts, and they must be considered as such because multiple cases show that the relationship between dietary fat as an independent variable and CVD is not a simple one.

The Complexity of Fat in the Diet

Medium Chain Triglycerides

Chain length of fatty acids increasingly proves to be a major factor in their metabolism. The majority of triglycerides in the diet are long chain triglycerides (LCT), which contain fatty acids that are 14 or more carbons long. Medium chain triglycerides (MCT), comprised of saturated fatty acids, all with 6-12 carbons, are far less abundant in the diet. The metabolism of LCT varies greatly from that of MCT. LCT are absorbed from the intestine by use of bile salts and are only transported to the liver via lymph (17). They are more easily incorporated into circulating phospholipids or cholesterol esters than MCT. Unlike LCT, MCT can be directly transported to the liver by traveling through the portal vein (17). Once in the hepatocyte, MCT are preferentially oxidized compared to LCT. MCT do not require the assistance of the carnitine palmitoyl transport shuttle (CPT1) to enter the mitochondria, while LCT do. Malonyl-CoA, a

product of β -oxidation, builds up due to the rapid β -oxidation of MCT (17). This then acts as a feedback inhibitor for CPT1, furthering the preferential oxidation of MCT over LCT (17). But what is especially intriguing about MCT is their capacity to influence both dietary cholesterol absorption and circulating phospholipid composition.

Consumption of MCT has been found effective for blocking the absorption of dietary cholesterol. Phytosterols (PS) and cholesterol have very similar configurations, only differing by their unsaturation level and/or side chain configuration (18). Cholesterol is preferentially absorbed in the small intestine over PS, but even minor incorporation of PS into micelles during the absorption process has significant implications, as they displace cholesterol from these micelles (18). This effect is enhanced in the presence of MCT. Von Bonsdorff-Nikander et al. compared the in vitro micellar uptake of cholesterol and/or PS in the presence of MCT or LCT (18). Results showed that, in the absence of PS, 100% of cholesterol was incorporated into micelles in the presence of LCT, compared to only 50.3% incorporation in the presence of MCT. When PS was administered in the absence of cholesterol, only 25% and 13% of the PS dose was incorporated into the micelles in LCT and MCT conditions, respectively, displaying the minimal micellar interaction of PS in the small intestine (18). But when co-administered with PS, cholesterol incorporation into micelles decreased from 100% to 85.8% (n=3) in the presence of LCT. This effect was enhanced in the presence of MCT; cholesterol incorporation into micelles was nearly halved, decreasing from 50.3% to 24.4% (n=3) (18). These findings directly contradict the report published by the AHA in '61, which had an influence on The Recommendations made in '77, that said reducing dietary cholesterol without reducing total dietary fat was unsafe because the body would synthesize cholesterol from other fat sources (9); in the case of MCT, added fat can decrease cholesterol levels even further.

St-Onge et al. assigned slightly overweight men to diets varying only in added fat type to investigate their effects on blood lipids (19). The control was a diet supplemented with olive oil, and the functional oil (FctO) was a mix of MCT oil, coconut oil (one of the only natural MCT sources), tall oil and flaxseed oil. The crossover study design followed two 4-week test periods separated by a 4-week washout (19). Both the control diet and the FctO contributed to the lowering of total cholesterol and LDL compared to baseline, but the effects were more pronounced with FctO (19). Changes in LDL particle composition were also observed with the FctO diet; LDL particle size was significantly increased ($P<0.05$) and the number of small and medium LDL particles was significantly decreased ($P<0.05$) compared to control (19). Small LDL particles are known to be the most atherogenic subtype due to their potential to penetrate the endothelial lining of arteries and become oxidized; this change found with FctO is therefore associated with a decreased risk for CVD. These findings, which are congruent with those of Von Bonsdorff-Nikander et al. (18), dispute The Recommendations to lower dietary fat to prevent heart disease. MCT, which are saturated by definition, have the capacity to improve blood lipid profile and therefore prevent heart disease.

Fat from Dairy Products

Dairy products like cheese and high-fat types of milk are often some of the first foods to be cut from the diets of dyslipidemic patients due to their cholesterol and saturated fat content. In 1965, 64.7% of Americans were regular consumers of whole milk. By 2002, this percentage had dropped to 39.4% (20). A Netherlands cohort study aimed to further understand the connection between saturated fat intake, specifically that from dietary sources, and ischemic heart disease (IHD) by comparing chain lengths and dietary sources of lipids (21). The main dietary contributors of saturated fat were cheese (17.4%), milk and milk products (16.6%) and meat

(17.5%) (21). By constructing 4 regression models, which enabled adjustments to be made for known IHD risk factors such as age, sex, total energy intake, BMI, waist circumference and lifestyle factors, the researchers were able to calculate hazard ratios (HRs) between total saturated fat intake, at the expense of intake of energy from all other dietary factors, and IHD incidence (21). After these multivariable adjustments, results showed greater IHD risk was not associated with higher intake of total saturated fat. Results even showed significantly lower IHD risks for each additional standard deviation of intake of saturated fatty acids from cheese or dairy sources (21).

Eggs as a Whole Food

Eggs are another important confounder of the low-fat recommendations. With 187mg of cholesterol in one large yolk, eggs had been considered adversaries of heart health for decades, spurred by the same studies upon which The Recommendations were based. In 1984, Time Magazine published an iconic cover story, “Hold the Eggs and Butter,” which warned readers against egg consumption in the name of lowering circulating cholesterol levels and therefore of CVD prevention. However multiple studies have shown egg consumption is not associated with an increased risk of heart disease. The Health Professionals Follow-up Study and the Nurses’ Healthy Study both concluded that those consuming >7 eggs/week displayed no increased risk of CVD compared to those consuming <1 egg/week (22). Nakamura et al. and Qureshi et al showed that more frequent egg consumption was not associated with increased CHD incidence or risk of stroke, respectively (23, 24). A prospective study conducted by Zazpe et al. found people in the highest of four egg consumption categories (>4 eggs/week) had no increased risk of CVD compared to those in the lowest consumption group (0 or <1 eggs/week) (25). Finally, a recent meta-analysis estimated pooled HRs of CVD, stroke and IHD. Data were compiled from 22

independent cohorts from 16 studies, ranging in size from 1,600 to 90,735 participants. Follow-up time ranged from 5.8 to 20.0 years (26). Meta-analysis found that individuals who consumed one or more eggs per day were not at higher risk of overall CVD, IHD or stroke compared to those who never ate eggs or ate less than one egg per week (26). No significant associations were found between egg consumption and overall mortality, either (26).

Eggs perfectly exemplify the necessity for both healthcare professionals and individuals to view what they eat as whole foods and not simply as sources of specific nutrients. Eggs are not only an inexpensive source of high-quality protein; they contain essential nutrients folate, riboflavin, selenium, choline, vitamin A and vitamin B-12 (27). Carotenoids lutein and zeaxanthin, found in amounts between 200 and 300 ug per yolk, also have positive health implications. Both are associated with reduced risk of age-related macular degeneration (AMD) and may be associated with a reduction in arterial plaque, therefore reducing the risk of CVD (27). The lipid matrix of eggs also makes these carotenoids significantly more bioavailable compared to when consumed from dark green leafy vegetables (27). Considering the multiple benefits of eggs, coupled with the fact that a reduction of dietary cholesterol results in a reduction of circulating cholesterol in only 30% of people (25), the apprehensiveness surrounding egg consumption must be reevaluated. However this cannot be fully achieved in the current anti-fat climate.

The Mediterranean Diet

The Mediterranean diet is the ultimate adversary to the low-fat diet approach. It is characterized by its high content of fruits, vegetables, cereals, bread, nuts and seeds, and olive oil. Animal products such as dairy, fish, poultry and eggs are consumed moderately. And what is especially notable about the Mediterranean diet is its relative lack of red meat in spite of its

relatively high total fat content. The Recommendations stated energy from dietary fat should be limited to <30% of total calories; however, the typical Mediterranean diet provides roughly 46% of total energy from fat (28).

Studies have repeatedly shown that adherence to a Mediterranean diet is associated with a decreased risk of incidence and mortality of CVD as compared to adherence to a low-fat diet, even for high-risk individuals (29). To explore this association, Esposito et al. (30) conducted a randomized, single blind prospective study of people with metabolic syndrome (MetS). Participants had to display at least 3 MetS criteria for a diagnosis, and were randomly assigned to either the intervention (n=82) or control diet (n=82) (30). Those following the intervention diet were recommended to follow a Mediterranean diet by increasing their intake of olive oil and by including at least 250 to 300g of fruits, 125 to 150g of vegetables, 25 to 50g of walnuts and 400g of whole grains (30). The control group was simply recommended to follow the same macronutrient breakdown as the intervention group, being 50%-60% carbohydrates, 15%-20% protein and <30% fat (30). After 2 years of follow-up, blood lipids and basic body composition measurements were taken. C-reactive protein (CRP) and interleukins 6 (IL-6), 7 (IL-7) and 8 (IL-8), which are positively associated with endothelial inflammation and thrombotic events, respectively, were also measured (30). Mediterranean diet followers were found to consume a significantly greater energy percent of complex carbohydrates, monounsaturated fat (MUFA) and polyunsaturated fat (PUFA). This group also consumed significantly more fiber, less total energy, less saturated fat, less cholesterol and a lower N-6:N-3 ratio than control (30). Follow up measurements between groups were significantly different; patients in the intervention group displayed decreases in body weight, BMI, waist circumference, blood pressure, blood glucose, total cholesterol and triglycerides and a significant increase in HDL, the extent to which were all

greater than the control group (30). Serum concentrations of CRP, IL-6, IL-7 and IL-8 were all significantly reduced in the intervention group compared to the control group (30). 60 intervention group members experienced reductions in at least one MetS criteria, leaving only 40 members of the group classified as having MetS. This was significantly different than the control group, in which 78 participants were still classified as having MetS at the 2-year follow up point (30).

Other Factors about CVD Mortality to Consider

These results support the notion that limiting fat as a macronutrient is not a comprehensive enough strategy to benefit heart health. The control and intervention diets displayed similar macronutrient breakdown and exercise levels, yet CVD risk factors were markedly different (30). The difference in the specific foods consumed is therefore the variable to be accounted for. Total dietary fat content cannot be singled out as a risk factor for CVD, simply because the data indicate the existence of other, stronger factors.

There are multiple possible variables to include when considering what actually caused the decrease in CVD mortality that has occurred since 1977. The recent decline of CVD-related deaths across the US is concurrent with a decrease in dietary saturated fat, but more importantly with a decrease in the *foods* contributing most of the saturated fat in the western diet. More specifically, red meat consumption, the original target of the dietary guidelines made by McGovern and his colleagues, has been on a decline since peaking immediately before The Recommendations in the early-mid 1970s (31). In the early 1960s, the US's meat consumption was twice as much as the developed world as a whole (31). The Recommendations then sparked a shift in attitude towards red meat, whose current downward consumption trend began around 1980. Smoking, another major risk factor, has declined; the percent of American adult smokers

has nearly halved since 1978, from 34.1% to 16.8% in 2013 (32). But what is probably most to thank for the lessened mortality of CVD is the improvement in healthcare over the past few decades; emergency response measures, blood pressure and cholesterol medications and life-saving procedures in hospitals have all progressed (33). All of these factors, and the overall increased public awareness of a healthy lifestyle, have contributed to the recent decline in CVD mortality. Nonetheless, the streamlined conception that dietary fat needed to be minimized persisted. Low-fat products and saturated fat alternatives became increasingly in demand, and the food industry adjusted accordingly.

The Food Industry's Role

The Increased Use of Soybean Oil

The Recommendations regarding dietary fat consumption and composition sent the average American, and therefore the packaged and processed food industry, into adjustment mode. First and foremost, saturated fats had become the enemy. Their use had to be replaced with other, seemingly less harmful alternatives. Soybean oil, rich in the omega-6 (n-6) polyunsaturated fatty acid linoleic acid (LA), largely filled this void. World War II forced America to limit the import of crops, so fats and oils had to be domestically available; soy was the answer. It provided high yield and nitrogen fixing capacity, was a good option for livestock feed, and was low-risk for farmers due to the passage of Public Law 480, titled *Food for Peace* (34). The law authorized the shipment of cheap, abundant and high-protein crops to nations in need of food aid, and eventually lead to the government subsidy of soybean crops. American soybean yield thus dominated global production through the 1970s. This overabundance allowed for exponentially greater use of plant- and unsaturated fat-based products soybean oil, margarine,

shortening and canola oil, which changed by 1163%, 1038%, 170% and 167%, respectively, from 1909 to 1999 (34). In fact, soybean oil, which accounted for only 0.006% of total calorie intake in 1909, became the fourth-largest contributor of American calories by 1999, with a total contribution of 7.38% (34).

The practical issue with soybean oil, however, is its relative instability that can result in lipid oxidation. Hydrogenation of these oils rendered them more stable, but also caused partial development of trans-fats. The process allowed for plant-based oils to take on the functionality of solid, saturated, typically animal-based fats. Therefore hydrogenated oils containing trans-fats, in the form of vegetable shortenings or margarines, became heavily used in packaged, shelf-stable foods to not only increase shelf life, but maximize sensory qualities due to the potential to selectively adjust the lipid to meet the needs of the product at hand (35). Hydrogenated oils gave foods the slippery mouthfeel of saturated fats and allowed for the incorporation of air into foods to impart proper texture. They made for flaky pie crusts, crispy crackers and fast food frying oils that could withstand multiple uses (36). Food companies' profit margins also increased due to the lower expenses associated with plant-based oils.

Fat Replacers

Although unsaturated fats and hydrogenated oils containing trans fats helped Americans steer away from the saturated fats they had been warned about, the recommendation to lower total fat intake to less than 30% total calories pressed the food industry to replace fat in foods completely without losing the sensory and physiological benefits it provides. Fat substitutes, macromolecules that resemble triglycerides and can theoretically replace fat on a one-to-one basis, became more widely available (37). These molecules are derived from lipids via enzymatic modification. Common roles for fat replacers include texturizing, emulsification,

plasticity and flavoring. A frontrunner for this category was olestra, patented as Olean by Procter & Gamble. It is a sucrose polyester engineered by the esterification of 6-8 fatty acid chains C12 or higher (37). In 1996, olestra was approved by the FDA to replace up to 100% of fats in savory snacks due to its inability to be absorbed in the small intestine; digestive lipases are unable to hydrolyze the large number and size of the fatty acids from sucrose (37). The discovery of olestra, however, didn't come without drawbacks. It has long been reported as causing gastrointestinal upset, such as cramping and loosening of stools (37). Some reports go as far to say olestra causes anal leakage. The lack of absorption of olestra in the small intestine also proved to have secondary effects; the absorption of fat-soluble vitamins consumed at the same time was significantly reduced (37). Because of this, the FDA's 1996 approval of olestra required a label on foods stating, "This Product Contains Olestra. Olestra may cause abdominal cramping and loose stools. Olestra inhibits the absorption of some vitamins and other nutrients. Vitamins A, D, E, and K have been added" (37). Although this label requirement was lifted in 2003, olestra was clearly not the food industry's solution to the low-calorie, low-fat market. The gastrointestinal discomfort left people dissatisfied with the low-fat alternatives to their favorite foods. Thus food scientists continued to innovate.

Other fat substitutes, largely engineered with the purpose of emulsification and stabilization, continue to grow in popularity. Sucrose fatty acid esters (SFEs) are especially applicable for emulsification, surfactant functionality and lubrication, and as stabilizers to prevent spoilage. Unlike olestra, SFEs only contain 1, 2 or 3 fatty acid esters and can be readily hydrolyzed by lipases. This keeps them from causing severe gastrointestinal upset, however they are also therefore caloric (37).

Fat mimetics, substances that mimic the sensory and physical properties of triglycerides but are not lipid-based, are also used. Fat mimetics bind water, which is helpful in controlling many sensory properties of food. However, this property thus makes them unsuitable for frying or sautéing (37). Common fat mimetics include gums, starch, cellulose, dextrans and pectin. Their practical uses include, but are not limited to, providing fatty mouthfeel, thickening, emulsion stability and improving syneresis. They are used in products ranging from salad dressings to ice creams to lunchmeats (37). Many fat mimetics are also used to stabilize emulsifiers. Emulsifiers contain both hydrophilic and lipophilic properties, enabling them to stabilize the interface between fat and water droplets (37). Emulsifiers' ability to mimic fat's effects on sensory properties allows for their replacement of up to 50% of fats in foods, but they work best in combination with other fat-replacers (37).

The Over-processing of Food

While scientists have been relatively successful in designing compounds that can work independently or synergistically to mimic desirable fat properties, their additions to foods do not come without downstream effects. Fat substitutes and mimetics are arguably not the transgressors in the low-fat movement, but instead act as a marker for the foods that are. Food and beverages containing these fat-replacers are largely found in the carbohydrate-rich snack and processed food aisles of the supermarket. Macronutrient breakdown of overall calorie intake was also investigated by Blasbalg et al. (34), who found that, although carbohydrates remained the primary source of energy throughout the 20th century, their consumption steadily declined until the 1970s (the decade where anything non-fat became in vogue), when their consumption began to rise again (34). Part of this increase can be attributed to the presence of caloric carbohydrate-based fat mimetics like starch and dextrans in popular low-fat foods. However it can also be

attributed to the addition of simple sugars to the same foods to enhance flavor; Gross et al. reported that the total per capita use of caloric sweeteners increased by 86% between 1909 and 1997 (14). The use of corn syrup sweeteners, specifically, which were virtually unused in 1909, increased more than 20-fold to provide Americans with 10% of their total daily calories by 1998 (14).

The Influence of Food Marketing and Labeling

Processed, highly brandable foods are heavily marketed to consumers to spread the perception that these foods are better for health than the ones in the produce section. To put into perspective the weight of the food industry's push of processed foods, Anthony Gallo (38) found that in 1997, food manufacturers spent \$2.66 billion on advertising convenience, snack, and confectionery foods. That same year, only \$159 million was spent on the advertising of fruits, vegetables, grains and beans combined- less than 6% of the processed foods' budget (38). This major discrepancy in advertising allowance has played a heavy hand in how and what Americans eat. A 2014 study showed that people exposed to food advertising were 28% more likely to choose an unhealthy snack than those not exposed (39). A study published in 2010 analyzed the nutritional value of a diet composed solely of foods advertised on TV during prime-time and Saturday morning cartoon programming in order to quantitatively assess the influence of TV marketing on the American diet. The diet exceeded the government's recommended daily amounts of fat by 20 times and sugar by 25 times, yet included less than half the recommended daily servings of fruits, vegetables and dairy (40). That year, the budget for advertisements of convenience, snack, and confectionery foods had increased to \$11.3 billion and the USDA's spending on nutritional education was \$268 million, less than 2% of the former (40). Foodmakers have even found a way to spin the USDA's campaigns in their favor. When the

guidelines came out suggesting Americans lower their fat intake to prevent heart disease, advertisements for low-fat versions of common packaged foods, and their subsequent sales, went through the roof.

A series of studies published in 2006 by Cornell University's Food & Brand Lab focused on how low-fat nutrition labels increase food intake by increasing the size of a perceived appropriate serving and decreasing consumption guilt (41). The first of three studies found that participants consumed 28.4% more of a provided hedonic snack (M&Ms) when they were simply labeled as low fat. This difference was especially noticeable in overweight participants, who consumed 16.7% more M&Ms than normal-weight participants (41). When asked to estimate how many calories the M&Ms snack contained, people presented with low fat labeling underestimated actual caloric value by 51 more calories than people who consumed regularly labeled M&Ms (41). The implications of this underestimation were compounded by a survey of normal and low-fat versions of 17 brands, which showed that, although low-fat versions contained 59% less fat, calories were only lowered by 15%. By this estimation, had people actually consumed low-fat M&Ms, they would have consumed 48% less fat but 9% *more* total calories than a serving of regular M&Ms (41). The second study in the series reinforced the indication that low-fat labels decrease perceived caloric density and increase perceived appropriate serving size by focusing on how guilty people felt after eating both hedonic M&Ms and nutritious-seeming, although calorically-matched, granola. It found that low-fat labels caused people to underestimate caloric value of both the M&Ms and granola by an average of 260 calories (41). Participants overestimated the serving size of the regular-fat versions of both snacks, but did so by an extra ounce for the low-fat versions. They also reported decreased guilt associated with overeating the low-fat variants (41).

The dietary recommendations forced America into a low-fat era. And while studies show that consumers perceive decreased calorie consumption while knowingly eating low-fat foods, total calorie intake actually increases. In fact, Gross et al. found an average increase of over 500 total daily calories per capita, a 9% change, from 1980 to 1997 (14). This was primarily due to increased carbohydrate intake, which accounted for 428 of the excess calories (14). Overall, the adjustments made by the food industry to function in an anti-dietary fat climate brought on by the dietary recommendations published in 1977 caused 3 things: 1) a total overhaul of the dietary fatty acid profile of the average American, 2) an increase in available dietary carbohydrates to compensate for the loss of sensory characteristics previously provided by fat and 3) an increase of total caloric consumption partially due to the perceived larger portion size of low-fat foods.

The Declining Health of Americans

BMI and Obesity Trends

BMI trends over the past half-century unequivocally show the existence of an obesity epidemic in the US. While the age-adjusted prevalence of men and women considered overweight (BMI 25.0-29.9) has remained fairly constant, the percent of men and women considered obese (BMI \geq 30.0) increased from 12.7% to 33.9% and 17.0% to 36.6%, respectively, from 1976 to 2012 (42). The percentage of people within the extremely obese BMI range (BMI \geq 40.0) also increased within these years. Only 0.4% of men and 2.2% of women were extremely obese in 1976-1980. This increased to 4.5% and 8.6%, respectively, in 2011-2012 (42). These BMI trends are mirrored in populations of all ages, from preschool to the elderly. Between 1976 and 1980, 5.0% of children aged 2-5 were obese (43). Although this percentage has declined since it peaked in 2003-2004 at 13.9%, the current rate of 10.4% is

significantly higher than it was during the years circumbient of The Recommendations (43). The obesity rate of those aged 65-74 roughly doubled from 1976-1980 to 2005-2006, increasing from 17.9% to 35.0% (44). The publication of the guidelines was effectively the starting line for the nation-wide BMI increase that afflicted all ages of the US population. This weight increase continues to have long-lasting negative health impacts.

Type 2 Diabetes Mellitus Trends

The prevalence of Type 2 Diabetes Mellitus (T2DM) has increased significantly since 1977. The age-adjusted rate of T2DM across America increased from 2.8 diagnosed cases per 100 individuals in 1980 to 6.4 in 2014 (45). Age of diagnosis has also been negatively affected. The National Health and Nutrition Examination Survey (NHANES) data recorded in 1988-1994 found the mean age at diagnosis of T2DM to be 52.04 years old. Data from this time period also showed discrepancies in age of diagnosis across different races; the white population was diagnosed at an average of 53.17 years old, the black population at 48.46 years old, and the Hispanic population at 50.32 (46). NHANES data collected just 5 years later, in 1999-2000, showed a drastic shift in these averages. The age of diagnosis for all groups had dropped significantly, to 46.43 years old for white Americans, 45.20 for black Americans and 45.08 for Hispanic Americans (46); the gap in age of diagnosis due to cultural predisposition was substantially narrowed by dietary alterations. The decrease of age at diagnosis has even had a trickle-down effect on American youth. Although it was once considered an adult disease, T2DM diagnoses in those aged 10-19 have become more frequent. 2009 statistics showed 0.46 diagnosed cases per 1000 youth, increasing 30.5% since 2001 (47). Projections suggest this rate will increase 4-fold by 2050 (47).

The American Diabetes Association recently revised their official current statistics: 1 in 10 US healthcare dollars is spent treating diabetes and its complications, and in 2012, diabetes cost the US \$322 billion in healthcare expenses and lost wages (48). Every year, diabetes kills more American people than breast cancer and AIDS combined, and it currently sits at the number seven spot for leading causes of deaths in the US. 29.1 million Americans, 9.3% of the population, are living with diabetes. And if present trends continue, 1 in 3 Americans will have diabetes by 2050 (48).

Added Sugars as a Contributor to Chronic Diseases

Considering that a nationwide *decrease* in dietary fat coincided with the *increase* in obesity and diabetes, dietary fat and diabetes lack a positive correlation. What does have a strong association with diabetes, however, is high carbohydrate intake. From 1909 to 1963, carbohydrate consumption actually followed a downward trend (14). It then began to climb, the speed of which accelerated significantly around 1980. This was largely due to corn syrup sweeteners, whose use, as previously noted, increased more than 20-fold from 1909 to 1997. And like total carbohydrates, corn syrup sweeteners’ use spiked around the time of the publishing of The Recommendations (Figure 1) (14). Specifically high fructose corn syrup has emerged as

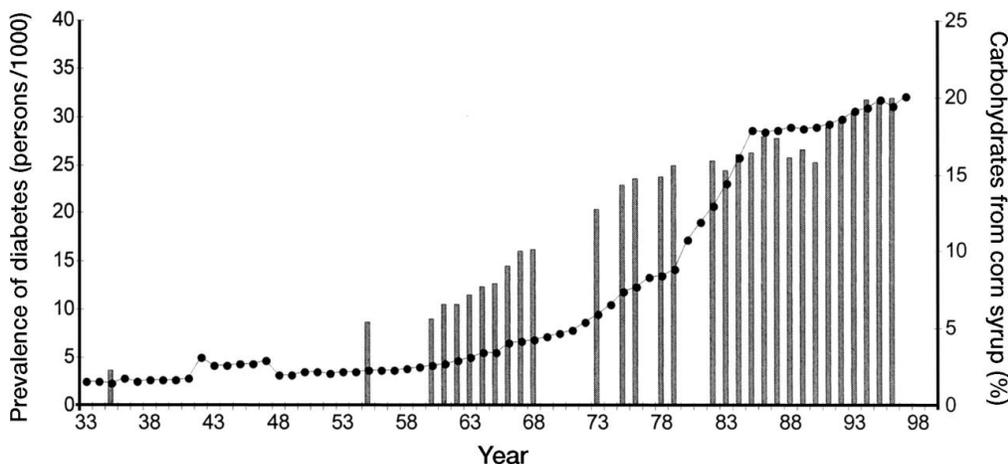


Figure 1- Increasing prevalence of type 2 diabetes (vertical bars) in the United States between 1933 and 1997 with increasing per capita percentage of carbohydrate intake from corn syrup (14)

a favorite of the food industry due to its relatively low cost and intense sweetness. But fructose has been implicated in many obesity-related disorders such as insulin resistance and metabolic syndrome (14). These effects are compounded by the fact that blood sugar-regulating fiber, whose consumption also declined leading up to 1963, never experienced the increase that other carbohydrates did (14).

Dietary Fatty Acid Composition as a Contributor to Chronic Diseases

A principal change of the typical Western diet made after The Recommendations was that of the sources and fatty acid composition of added fats and oils. The use of two major sources of added saturated fats, butter and lard, decreased from 8.1 and 5.8kg to 2.2 and 1.3kg per capita consumption, respectively, during the course of the 20th century (34). But the use of soybean oil and hydrogenated margarines increased in an over compensatory fashion, increasing from 0.01 and 0.3kg to 11.6 and 3.6kg per capita consumption, respectively, over the same time span (Figure 2) (34). This has resulted in soybean oil being the number one source of LA in

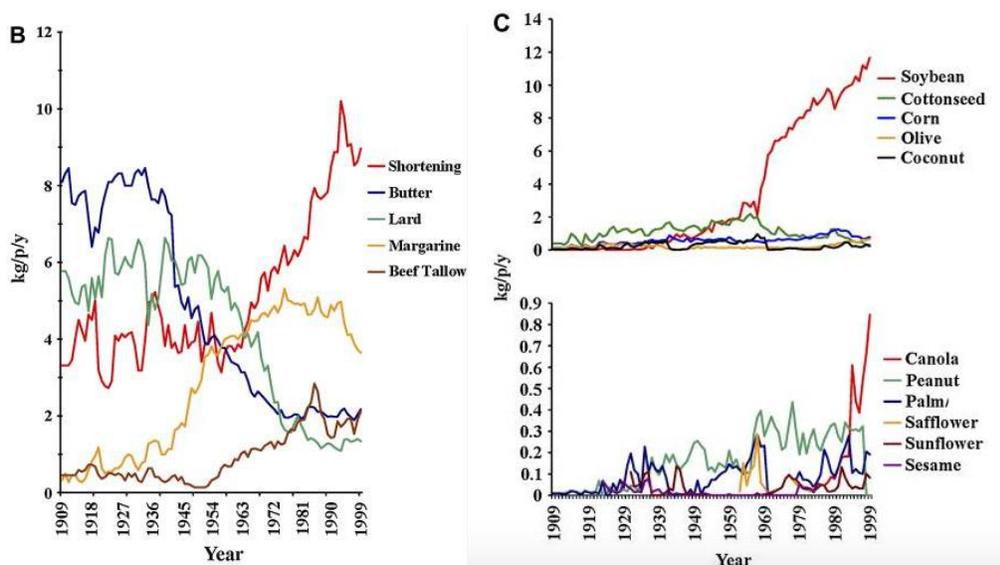


Figure 2- Trends in the estimated per capita consumption of major fat commodities (B), and vegetable and seed oils (C) between 1909 and 1999. kg/p/y, kilograms per person per year. (34)

the U.S., accounting for 43.11% of total LA intake in 1999 (34). It has also caused the nationwide dietary n-6 to n-3 ratio to increase 77%, and the LA content of mature human breast milk to increase from 6%-7% in 1945 to 15%-16% in 1995 (34).

The increased consumption of soybean oil and therefore of n-6 has unclear implications. While some studies find no conclusive evidence of LA's involvement in pro-inflammatory pathways, others conclude that LA does play a role. Young et al. (49) found that treatment on endothelial cells with LA increased cellular oxidative stress, nuclear factor- κ B (NF- κ B) activation, interleukin-8 (IL-8) production and intercellular adhesion molecule-1 (ICAM-1) levels, all of which relate to either inflammatory or immune responses (49). These increased stress responses can lead to a chronically weakened immune system and vital organs, which can allow for the development of preventable conditions like CVD, kidney disease and infection down the line. However the increase of LA is particularly alarming in congruence with the decrease of dietary n-3 over the same period of time. By using an empirical equation developed by Lands et al (50), it has been predicted that the content of n-3s eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in highly unsaturated fatty acids (HUFAs) in tissue phospholipids has decreased by 27%, from 31.28% to 22.95% (34). This is concerning; a low percentage of n-3 in tissue HUFAs can be indicative of a higher risk of diseases ranging from psychiatric disorders to insulin resistance to CVD (34, 36). This decline is likely directly due to the overconsumption of LA through its competition for the active site of Δ^6 -desaturase, the enzyme that converts α -linolenic acid (ALA) into the active forms of both DHA and EPA (34). An increased consumption of LA directly reduces the capacity for Δ^6 -desaturase to produce DHA and EPA.

Trans Fats as a Contributor to Chronic Diseases

The final contributor to the decline of Americans' health was the widespread acceptance of trans fats to replace the function of saturated fats while still maintaining a plant-based appeal. But trans fats have repeatedly proven to be even more detrimental than saturated fats. They have been linked to an increased risk of CVD by negatively affecting lipoprotein metabolism, endothelial function and cytokine production (51). To understand the metabolic implications of trans-fatty acids in the diet, Dorfman et al. (51) fed Sprague-Dawley rats either a low fat diet including 10% energy from trans-fats (LF-trans), a low fat diet including 10% energy from saturated fats (LF-sat) or a high-fat diet including of 45% energy from saturated fats (HF). At the end of 6 weeks, the increase in overall adiposity of the LF-trans group (0.07 +- 0.01g) more closely resembled that of the HF group (0.08 +- 0.02g) than the LF-sat group (0.04 +- 0.01g), and this pattern was mimicked for hepatic triglyceride content (51). The fat accumulation in the HF group was dispersed between subcutaneous and visceral deposits, but the fat of the LF-trans group was primarily located in the visceral region (51). This is alarming, considering high visceral fat accumulation is linked with MetS, CVD and T2DM. The LF-trans group also displayed significantly lower tissue DHA as well as higher elaidic acid concentrations, which are indicative of lower HDL levels, though not explicitly measured. Trans fats were also associated with decreased glucose disposal (51). By influencing MetS criteria (high waist circumference, low HDL, high blood glucose), a diet containing a significant amount of trans fats was therefore shown to potentially induce MetS.

In Summary

The Recommendations had Americans' health as a whole in mind; they acknowledged the necessity to decrease sugar intake and suggested the decrease in saturated fat be

complemented with an increase in mono- and poly-unsaturated fats in the name of heart health. But in the translation from the committee to health care professionals to individuals, the goals were watered down and simplified. What Americans were left with was a much too narrow-minded version of what was originally published, resulting in a specific targeting of dietary fat. Whether it was intentional or simply nationwide miscommunication, it became accepted as fact that decreasing dietary fat was a cure-all for a wide variety of the US's ailments. A dietary alteration did contribute to the lowering of mortality from CVD, The Recommendations' top priority, but its consequences outweighed this accomplishment. Other previously less prominent diseases have quickly increased in relevancy. The alienation from fat in the American diet left room for other unhealthy dietary constituents, and also decreased the ability for certain healthy fats to meet their potential to fight off disease.

Recommendations for the Future

Calls for Food Labeling Reform

The attention dedicated to saturated fats must be redirected towards processed foods and their high calorie and sugar content. 2009-2010 NHANES data found almost 60% of calories consumed in the United States were from 'ultra-processed' foods, defined as formulations and ingredients not used in culinary preparations such as sweeteners, emulsifiers and additives. The same foods accounted for 90% of the country's added sugar intake (52). And despite the most recent dietary guidelines recommending less than 10% of daily calories come from added sugar, data showed an average of 14.4% of daily calories from added sugar (52). Therefore to improve the country's health, changes must be made at the food industry's level. This should begin with food labels.

As demonstrated by the Cornell Food & Brand Lab in 2006, food labels are powerful (41). They can completely alter a person's perception of a food and its nutritive value by simply including certain buzzwords. "Low-fat" seems to be one of the most powerful phrases a package can display. Dr. Dean Ornish of the Preventative Medicine Research Institute reported that patients gained substantial weight by eating multiple snack cakes at meals. The patients misinterpreted the cakes' 'low-fat' labels as being conducive to weight-loss (53). Consumers feel virtuous when they eat a low-fat food and end up overcompensating for spared fat calories; the phenomenon has become so common that professionals have given it a name: 'dietary schizophrenia' (54). Low-fat designations must therefore be among the first subjects of labeling legislature. Current regulations mandate a food can be considered 'reduced fat' if the food "contains at least 25 percent less fat per reference amount customarily consumed than an appropriate reference food" (55). However what constitutes an appropriate reference food is ambiguous; a reduced fat product may contain 25% less fat than a generic version of the food, but not 25% less than *that brand's* regular version of the food. Regulations also state that the percentage of fat reduced must be visible in immediate proximity to the primary nutrition claim, which is often on the front of a package. But quantitative information regarding the fat content (ex. 'This low-fat product contains 4g fat/serving compared to 6g/fat serving'), which would provide the consumer with a more explicit concept of the nutritive difference, is only required to be in paragraph form on the nutrition panel printed on the back of a package (55). I therefore propose three changes be made to low-fat labeling: 1) Foods may only be marked with a low-fat label if both the total calories and fat content are reduced at least 25% as compared to the brand's regular version of the food; 2) Unless meeting federal low-calorie criteria, low-fat foods must display "This is not a low-calorie food" adjacent to the primary nutritive claim on the front of the

package; 3) Low-fat foods must display the nutrition panel of the regular-fat product adjacent to the low-fat nutrition panel for easy comparison.

A recent surge in popularity of organic and natural foods has allowed the food industry to use ‘organic’ and ‘natural’ labeling as lures for consumers who believe natural versions of foods have healthier macronutrient profiles. Some well-intended regulations have been put in place; foods made of entirely organic ingredients excluding water and salt may be labeled ‘100% organic,’ foods containing at least 95% organic ingredients may be labeled ‘organic,’ and foods containing at least 70% organic ingredients can claim to be ‘made with organic ingredients’ (56). But beyond that, labels and their interpretation become less clear. No regulations are in place to control the use of terms such as ‘natural,’ ‘free range’ or ‘sustainably harvested,’ amongst others. This allows companies to display these words in attempts to be synonymous with improved nutritional value, despite extremely similar nutrition panels. Annie’s Naturals, a maker of ‘natural’ and organic versions of American comfort foods, produces ketchup containing identical sugar content as Heinz at 4g/serving. Agave syrup has also found success in its ‘natural’ marketing; while it is in fact derived from a plant, it undergoes a refining process similar to any plant-based syrup and results in a product whose sugars are comprised of an average of 90% fructose. However consumers are led to believe that the bottle with the word ‘natural’ displayed across the front is healthier. Again, I propose a revision of the bylaws regarding products utilizing ‘natural’ labeling. Regulations should be put in place limiting the amount of refining done on ingredients such as sugars and oils. This will require ‘natural’ products to resemble whole foods as closely as possible. ‘This is not a low-calorie food’ should also be displayed in close proximity to the primary ‘natural’ claim on the front of packages to prevent misinterpretation.

Aside from the required inclusion of trans fat content mandated in 2006, nutrition panels on products have remained unchanged since the early '90s (57). Added sugar, whose overconsumption unequivocally leads to chronic disease, is still only represented as amount in grams on labels. But to the average consumer, this measurement carries little meaning. Three immediate regulations should be made regarding sugar content of processed foods. First, nutrition labels should list added sugar as a percent of the daily allowance in order to increase nutrition literacy and give the consumer a clearer reference of how much sugar he or she is truly eating. Second, foods containing at least 40% of total calories from added sugar should be labeled as being a 'high sugar food' on the front of its packaging.

Finally, serving sizes of processed foods must be reassessed to more accurately reflect the amount of a food typically consumed per serving. Currently, food companies manipulate listed serving sizes to display favorable values on a product's nutrition panel. This is especially true with high-sugar foods; soda and ice cream, whose serving sizes are listed as 8 fluid ounces and ½ cup on a 20-ounce bottle and 1-pint container, respectively, are almost always consumed in greater amounts (57). This is mirrored in the results from Cornell's Food & Brand Lab; consumers consistently underestimated their consumption of snacks (41). In order to improve nutrition panel accuracy, the FDA should require brands to conduct consumer panel testing to determine a more precise serving size for a food before its release to market.

Calorie count should, in turn, exactly reflect these serving sizes. Currently, calorie count can be rounded to the nearest 5-calorie increment in foods containing ≤ 50 calories per serving, and to the nearest 10-calorie increment in foods containing > 50 calories per serving (58). This discrepancy can be misleading; spray oils, for example, are listed in serving sizes of an average of 2.5 spray plunges (I Can't Believe It's Not Butter! Original Spray) or a continuous spray

lasting $\frac{1}{3}$ of a second long (PAM Original Canola Cooking Spray). And in accordance with regulation, these products are labeled as calorie-free because these serving sizes contain less than 5 calories (58). But in reality, these products are rarely utilized in such small amounts.

Consumers are led to believe these fat-based products truly contain 0 calories and proceed to use them in excess. Displaying exact calorie content can minimize this miscalculation.

Necessity to Rethink Dietary and Mealtime Habits

Moving forward, Americans themselves must focus on their overall diet patterns.

Mealtime habits, for example, play an important role in how much food people eat and how satiated they feel. As technology's presence in homes continues to increase, so does its ability to distract people while eating. A recent meta-analysis found that when people were distracted while eating, they consumed an average of 10% more calories compared to when they attentively ate the same foods (59). This increased to a 25% calorie difference at meals a few hours later because subjects had simply forgotten how much they had already eaten that day (59). Had the meta-analysis also accounted for food advertising's impact on appetite during distracted eating, these differences would surely have been even greater. Regardless, these findings show that people should refrain from engaging in distracting activities at meals to reduce over-eating.

Attentive eating can help regulate serving size and improve satiety via cognitive appetite control, and therefore even act as a weight loss tool.

Roughly 40% of American calories come from foods that are not ultra-processed.

However the profile of these foods still needs a revision. First, Americans should focus on incorporating fats with proven health benefits into their diet, such as plant-based ones rich in n-3 fatty acids or MCTs. This can be as easy as substituting olive or coconut oil for soybean-based oils used for cooking and flavoring, or replacing red meat with fatty fish once per week. While

calorie content may be somewhat similar, these foods can result in lasting health benefits such as an improved n-3:n-6 ratio. Semi-processed sources of sugar in the diet should also be exchanged for whole foods containing sugar such as fruits to incorporate beneficial compounds such as fiber and carotenoids.

It is important to note, however, that these healthier food options should also be consumed in moderation. The reduced intake of a specific food is not a sufficiently comprehensive strategy to improve overall health, especially if total per capita calories from these sources continue to increase. Red meat, for example, has been consumed in declining amounts since the original dietary recommendations in 1977. But poultry, the low-fat, heart-healthy alternative, has been consumed in increasing amounts since the 1950s (31). However poultry consumption has increased in such an overcompensatory fashion that meat's total caloric load has continued to increase (31). Beverages have followed a similar pattern. Dairy products, specifically whole fat milk, had been targeted for dietary reduction. From 1965 to 2002, whole milk consumption decreased by 9 daily calories per capita. Over the same period of time, however, fruit drinks and soda increased by 99 and 129 daily calories per capita, respectively (20). In fact, statistical analyses show that all beverages with the exception of whole milk actually increased in per capita calorie consumption during these years (20). These trends show that the average American may not have a sound enough understanding of basic nutrition and the value of a calorie. The US Government must therefore make more of an investment in the health of its citizens by improving nutrition education. This can be through many avenues including implementing more intensive public school programs, providing tax deductions for health-improving measures such as the purchase of a gym membership or by broadcasting more

nutrition-related TV advertising. By spending more money on preventative health measures, less will have to be spent down the line to fix health issues.

The Most Recent Edition of the Dietary Guidelines for Americans

Thankfully, national attitudes towards what Americans eat are becoming more comprehensive. A newly updated version of the *Dietary Guidelines for Americans* was published in 2015. They are as follows:

- 1. Follow a healthy eating pattern across the lifespan.** All food and beverage choices matter. Choose a healthy eating pattern at an appropriate calorie level to help achieve and maintain a healthy body weight, support nutrient adequacy, and reduce the risk of chronic disease.
- 2. Focus on variety, nutrient density, and amount.** To meet nutrient needs within calorie limits, choose a variety of nutrient-dense foods across and within all food groups in recommended amounts.
- 3. Limit calories from added sugars and saturated fats and reduce sodium intake.** Consume an eating pattern low in added sugars, saturated fats, and sodium. Cut back on foods and beverages higher in these components to amounts that fit within healthy eating patterns.
- 4. Shift to healthier food and beverage choices.** Choose nutrient-dense foods and beverages across and within all food groups in place of less healthy choices. Consider cultural and personal preferences to make these shifts easier to accomplish and maintain.
- 5. Support healthy eating patterns for all.** Everyone has a role in helping to create and support healthy eating patterns in multiple settings nationwide, from home to school to work to communities. (60)

These guidelines emphasize the importance of establishing healthy and sustainable eating patterns to promote long-lasting health. A ‘healthy eating pattern’ was then defined:

A healthy eating pattern includes:

- A variety of vegetables from all of the subgroups—dark green, red and orange, legumes (beans and peas), starchy, and other
- Fruits, especially whole fruits
- Grains, at least half of which are whole grains
- Fat-free or low-fat dairy, including milk, yogurt, cheese, and/or fortified soy beverages
- A variety of protein foods, including seafood, lean meats and poultry, eggs, legumes (beans and peas), and nuts, seeds, and soy products
- Oils

A healthy eating pattern limits:

- Saturated fats and *trans* fats, added sugars, and sodium
- Consume less than 10 percent of calories per day from added sugars
- Consume less than 10 percent of calories per day from saturated fats
- Consume less than 2,300 milligrams (mg) per day of sodium
- If alcohol is consumed, it should be consumed in moderation—up to one drink per day for women and up to two drinks per day for men—and only by adults of legal drinking age (60).

While these recommendations are more comprehensive than those prior, improvements can still be made to future editions. The 2015 Guidelines were principally based on *The Scientific Report of the 2015 Dietary Guidelines Advisory Committee* (DGAC); its role was equivalent to that of the *Diet Related to Killer Diseases* hearings prior to the 1977 recommendations. However the current guidelines do not completely encompass the DGAC's findings. The report states a high intake of red and processed meat was repeatedly found to be detrimental to health, yet the published guidelines simply recommend eating a variety of protein foods (61). The DGAC also acknowledges how significant of a contribution the Western diet makes to greenhouse gas emission, as compared to Mediterranean or vegetarian diets, due to its high animal product content (61). However the guidelines make no specific recommendation to lower the intake of animal products. The DGAC also mentioned the need to further investigate the safety of aspartame, a point ignored by the guidelines (61).

It is important to acknowledge, however, how much has improved since the original recommendations made in 1977. In the new version, the executive summary acknowledges the interconnected relationship between dietary components and therefore recommends healthy eating patterns be applied in their entirety to maximize effectiveness. While the limit on percent of daily calories from saturated fat remains, restrictions on total fat and cholesterol have been lifted. Conversely, recommended allowance of percent of total daily calories from added sugars has decreased from 15% to 10%, and trans fats have been identified as a component of an

unhealthy eating pattern. Both of these changes are in accordance with the repeatedly observed causal influence of added sugar and trans fats on chronic disease.

The dietary recommendations made in 1977 initiated an era of nutritional confusion lasting roughly four decades long. But the new recommendations indicate the government has established a trajectory towards a more comprehensive understanding on the diet's role in overall health. If this precedent is followed by both the food industry and by individuals, the occurrence of obesity and related diseases will begin to diminish.

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