Consumer Federation of America

Ultra-processed Foods: *Why They Matter and What to Do About It*

A Consumer's Guide to Better Eating and Public Policy


CFA
Consumer
Federation
of America

Table of Contents

Ultra-processed Foods: *Why They Matter and What to Do About It*

A Consumer's Guide to Better Eating and Public Policy

Authors: Thomas Gremillion & Kathleen McCann

Executive Summary

Ultra-processed foods (UPFs) dominate the American diet. Now, growing research suggests these food products are driving the nation's obesity epidemic. Coined in 2010, "ultra processed" has become a buzz word among wellness gurus, and a lightning rod for industry critics, who complain that it groups food products in an arbitrary, "unscientific" fashion. Despite this criticism, researchers have operationalized the "Nova classification" system behind UPFs, defining foods based on whether they contain ingredients that are "industrial formulations" or "rarely used in home kitchens," and their findings have linked UPF products to health problems ranging from cardiovascular disease and cancer to depression and dementia. The mechanisms by which UPFs cause the most harm remain uncertain, but evidence available now supports advice to limit UPFs in the diet, particularly among consumers struggling with diet-related disease.

The leading theories of how UPFs cause disease focus on their role in contributing to overeating. They suggest UPFs' soft texture and modified food matrix, hyperpalatable formulations, and flavor additives, may effectively "hijack" the brain and override satiety signals that prevent us from overeating less processed foods. But certain chemicals in UPFs may affect us in more complex and nefarious ways as well, degrading the gut microbiome, disrupting the endocrine system, and even stymying healthy brain development. Different policies will address these harms with varying efficacy.

Fortunately, policymakers have many feasible options available to reduce the harms associated with UPFs. Closing regulatory loopholes that allow untested or dangerous chemicals into the food supply, educating consumers through dietary guidelines and front-of-pack labeling, leveraging federal food programs like SNAP and school meals to shift the food environment, shielding children from food marketing, and fostering competition, are just a few of many promising strategies to improve public health by targeting UPFs. These policies will necessarily disrupt business-as-usual, and the profit incentives that have fueled the rise of UPFs. But with consensus growing across socioeconomic and political divides that the status quo is intolerable, the time is ripe for reform.

I. Introduction

Ultra-processed foods (UPFs) make up an increasing share of U.S. consumers' diets, and attract increasing blame for the nation's diet-related chronic disease epidemic. More than 70% of the food sold in U.S. supermarkets is ultra-processed.[1] Two-thirds of U.S. children's calories[2] and 60% of those in adults' diets come from ultra-processed foods.[3] Compared to their European counterparts, U.S. supermarkets stock 40% more ultra-processed staple foods.[4]

Despite this ubiquity, many U.S. consumers and policymakers remain unfamiliar with the UPF concept, and why it matters to public health. The UPF category signals a move away from traditional, household food preparation practices, towards industrial formulations made from substances extracted from foods (e.g. oils, sugars, proteins). Under the most widely applied definition, a food's ingredients determine whether it is UPF. Using this definition, an extensive and growing body of research has linked UPFs to a wide range of adverse health effects, including increased mortality, cardiovascular disease, obesity, cancer, metabolic disorders such as diabetes, and poor mental health.[5][6] Yet because UPFs are so ubiquitous and varied, researchers have struggled to specify exactly how they harm health, i.e. their mechanisms of action.

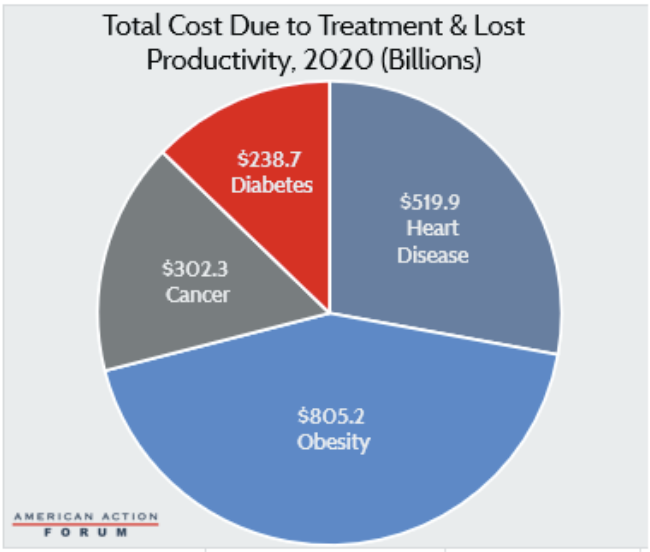
This paper presents some of the leading theories on how UPFs harm health, the supporting evidence, and possible reforms to reduce the harms associated with UPFs. Because different UPF related harms support different interventions, continued research will help to clarify which policies deserve priority. However, the evidence available now points to a need for building greater public awareness of UPF harms, and this guide is intended to contribute to those efforts.

The evidence available now also makes clear that public policy has failed to adequately protect consumers from UPF harms. The history of food safety regulation in the United States, spearheaded by the Food and Drug Administration's founder, Harvey Wiley, centered around a preoccupation with protecting consumers from unsafe chemical additives in food. In 1906, Congress outlawed selling a food containing "any poisonous or deleterious substance which may render it injurious to health."[7] In the years since, federal food safety agencies have applied

this law to protect consumers from microbiological pathogens and other contaminants that cause acute foodborne illness. But with one in five children now suffering from obesity, consumers need better protection from "injurious" food.

II. Background: The Rise of Obesity and Diet-Related Disease

The toll of unhealthy diets in the U.S. is hard to overstate. About 678,000 Americans die each year from nutrition and obesity related diseases, resulting in Americans having the shortest lifespans of the 20 leading developed countries.[8][9] U.S. children increasingly suffer from diseases that in the past only affected adults, such as type-2 diabetes and fatty liver disease (now referred to as metabolic dysfunction-associated steatoic liver disease).[10] U.S. consumers now spend hundreds of billions of dollars—more than a trillion dollars according to some estimates[11]—treating diet-related disease. Compared to adults with normal weight, obese individuals[12] incur an average $2,505 in higher annual medical care costs.[13] Research by Global Data estimated that in 2022, obesity and overweight detrimentally impacted New York's state budget by $5.2 billion.[14] Across the nation, researchers estimate that nutrition-related chronic diseases cost $16 trillion over the period from 2011 to 2020.[15]



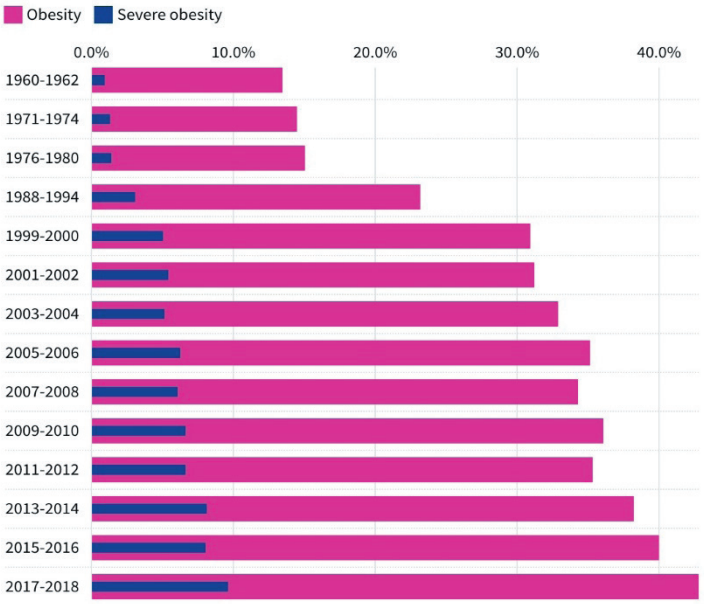
Source: O'Neill Hayes, T., & Asres, R. (2022). The Economic Costs of Poor Nutrition. American Action Forum. https://www.americanactionforum.org/research/the-economic-costs-of-poor-nutrition/

Diet-related disease has manifested in varied and novel ways.[16] A study of over 900,000 COVID-19 hospitalizations in the U.S. in 2019 and 2020 found that 63.5% of them associated with cardiometabolic conditions like obesity and diabetes that are linked to diet.[17] Across the world, researchers found that COVID-19 mortality risk was 10 times higher in countries where most of the population was overweight, like the United States, as compared to countries where less than half of adults were overweight.[18]

Unfortunately, obesity rates show little signs of abating. The latest from the Centers for Disease Control and Prevention (CDC) indicates that 41.9% of U.S. adults aged 20 and over suffer from obesity, and when the "overweight" designation is added, some 73.6% of adults are affected.[19] In other words, barely a quarter of the U.S. adult population today has managed to avoid excessive weight gain, with the epidemic disproportionately affecting historically disadvantaged groups, including consumers with lower levels of education and Black, Hispanic and Native American consumers.[20][21]

Nationwide obesity rates have more than tripled since the 1960s.

Age-adjusted nationwide obesity and severe obesity rates according to National Health and Nutrition Examination Surveys



Source: USAFACTS using Centers for Disease Control and Prevention, National Center for Health Statistics data for population between the ages of 20-74

The numbers of Americans with obesity remains stubbornly high in part because efforts to shed unwanted pounds run contrary to metabolic processes deeply rooted in how our bodies evolved.[22]

NIH researchers demonstrated these dynamics in a groundbreaking study that measured the "resting metabolic rate" ("RMR") of 14 contestants on the television show, "The Biggest Loser," who competed to lose more weight than other contestants during the show through intensive dietary and exercise interventions. RMR, also known as resting energy expenditure, is the amount of energy a person's body uses while at rest to perform essential functions like breathing, circulating blood, and maintaining a constant body temperature. Someone with a higher RMR will burn through calories from a meal more quickly than someone with a lower RMR.

In "The Biggest Loser" NIH study, researchers found, consistent with previous observations, that RMR plummeted for contestants during the weight loss competition, meaning that as the contestants lost weight, their bodies adjusted to conserve energy.[23] Also consistent with previous research, the contestants who lost more weight during the competition had greater declines in RMR. Surprisingly, however, these metabolic changes persisted over many years. The researchers continued to measure 14 contestants' RMR after the competition, and found that "despite substantial weight regain in the 6 years following participation in The Biggest Loser, RMR remained suppressed at the same average level as at the end of the weight loss competition."[24] The contestants "who were most successful at maintaining lost weight after 6 years also experienced greater ongoing metabolic slowing."

Danny Cahill lost 239 pounds to win the 2009 season 8 of The Biggest Loser, whose contestants were the subject of an NIH longitudinal study.

The "Biggest Loser" study demonstrates why so many people struggle to maintain weight loss after a "successful" diet. Once the body reaches a new "set point" for weight, it defends against efforts to reduce weight with metabolic changes that fall outside our voluntary control. A person with the good fortune to have avoided excess weight gain will tend to have a higher RMR and be able to consume more calories to maintain a given weight than someone who, like the "Biggest Loser" contestants, has gained, and then lost, significant body weight. This is because the experience of losing weight causes RMR to decline, and so condemns the weight loss patient to have to consume fewer calories to maintain the same weight as someone who never experienced excessive weight gain in the first place.

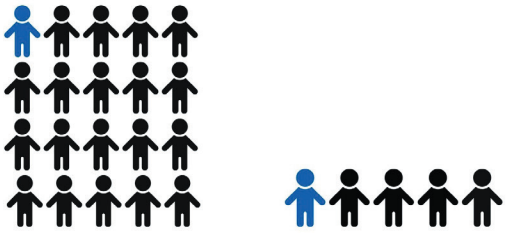
Of course, many people, including several of the Biggest Loser contestants, achieve long-term weight loss despite these challenges, and new weight loss drugs have fueled hopes that more can do so. However, the evidence underscores the difficulty these patients face. In 2016, researchers calculated the likelihood of a patient with obesity achieving a "normal" weight in a given year at 1 in 210 for men and 1 in 124 for women.[25] New GLP-1 drugs may improve these odds, but probably not dramatically. A study of nearly 2000 adults with obesity taking semaglutide, the active ingredient in the blockbuster diabetes and weight loss drugs Ozempic and Wegovy, found that patients typically experience a plateau in their progress around the 60-week mark of using the drugs, falling short of their goal weights.[26]

Genetics play a large role in determining who suffers from diet-related disease in today's food environment. Studies comparing outcomes among fraternal (dizygotic) and identical (monozygotic) twins suggest that a genetic component accounts for 40-50% of individual variation with respect to obesity.[27] Technological advances have enabled more nuanced "genetic epidemiology" that suggest the heritability of bodyweight varies significantly among groups, with genetics accounting for just 30% of "variability in body weight status" for "normal weight individuals," but up to 80% of variability among individuals with obesity and severe obesity.[28]

The notion that certain genetic mutations account so much for those who suffer from obesity, however, should not obscure the impact of the food system on diet-related disease. As former NIH Director Francis Collins has said, "genetics loads the gun, and environment pulls the trigger."[29] A significant proportion of the population has always carried genetic risk factors for obesity and other diet-relat-

ed disease, but relatively recent changes in the food system have transformed these genetic variants into a crippling liability.

Indeed, obesity rarely affected children in the U.S. just a few generations ago.[30] Yet today, one in five kids under age 19 qualify as "obese,"[31] and the upward trend shows little sign of abating, with obesity occurring at younger ages, with greater severity, in a more inequitable fashion.[32] Diet-related disease in kids has occurred so rapidly that it has forced medical nomenclature to adjust. Practitioners once referred to type 1 diabetes as "juvenile diabetes" and type 2 as "adult-onset diabetes." But recent data indicate tens of thousands of children now suffer from "adult-onset" diabetes, with incidence rates as high as 1.8% among Black or African American youth.[33] Given the chronic nature of obesity and diet-related disease, policies to prevent these diseases in children carry a heightened moral urgency.



Data from von Hippel, P. T., & Nahhas, R. W. (2013). Extending the history of child obesity in the United States: The Fels longitudinal study, birth years 1930–1993. Obesity, 21(10), 2153–2156. https://doi.org/10.1002/oby.20395 and Childhood Obesity Facts. (2024, June 4). Centers for Disease Control. https://www.cdc.gov/obesity/php/data-research/childhood-obesity-facts.html

Currently, the diet-related disease epidemic shows little signs of relenting, particularly for the nation's most vulnerable consumers, but cause for optimism exists. Americans increasingly identify obesity as a top public health threat,[34] and recognize the importance of factors like genetics and the food environment—rather than blaming individuals' failure of willpower.[35] This shifting public sentiment should lead to better policies, which studies show can make a difference. For example, changes to the "WIC" federal food assistance program ("Special Supplemental Nutrition Program for Women, Infants, and Children"), including more support for breastfeeding, are credited with significant declines in obesity among young children (aged 2-4) whose families were enrolled in WIC.[36] Similarly, researchers credit the Healthy, Hunger-Free Kids' Act with slowing the growth of obesity rates among school-aged children.[37] Public policy can do much more to combat diet-related disease, in part by reducing the harms associated with UPFs.

III. The emerging consensus around ultra-processed foods.

While diet-related disease has claimed an increasing number of lives, U.S. consumers' and particularly U.S. children's UPF consumption has increased, highlighting the lack of public awareness about the links between UPFs and adverse health effects. According to one recent analysis of data from 1999 to 2018, the percentage of kids' calories from UPFs increased from 61.4% to 67.0%, while the percentage of calories from unprocessed or minimally processed foods decreased from 28.8% to 23.5%. Of course, correlation does not always signify causation,[38] and many factors, including increases in restaurant portion sizes and snacking frequency, if not decreases in physical activity, have likely played an important role in the ongoing epidemic.[39] Nevertheless, an increasing body of evidence fingers UPFs as a key culprit behind our dietary woes, and suggests that raising awareness about their suspected hazards could assist consumers in building a healthy diet and avoiding excessive weight gain, and create support for effective policies to reduce diet-related disease.

A. What's special about UPFs?

"Ultra-processed foods" describes one of three categories defined by Brazilian researchers in a 2010 paper that introduced the "Nova" (Portuguese for "new") classification system.[40] The paper defined the other categories as "unprocessed or minimally processed foods (group 1)," and "processed culinary and food industry ingredients (group 2)."[41] More recent formulations separate culinary ingredients (group 2) from "processed foods" (group 3) but the greatest emphasis remains on the category at the furthest end of the processing spectrum: UPFs.[42]

According to the Nova classification's architects, "ultra-processed foods are formulations of ingredients, mostly of exclusive industrial use, that result from a series of industrial processes."[43] The researchers concede that determining when a given product falls under the UPF definition can be tricky, in part because manufacturers do not

always disclose the extent to which they rely on "industrial processes." As a practical matter, therefore, the authors advise consumers to consult "the ingredients labels that by law must be included on pre-packaged food and drink products." If that list "contains at least one item characteristic of the ultra-processed food group, which is to say, either food substances never or rarely used in kitchens, or classes of additives whose function is to make the final product palatable or more appealing ('cosmetic additives')," then the product is a UPF. Examples of these ingredients include "hydrolysed proteins, soya protein isolate, gluten, casein, whey protein, 'mechanically separated meat', fructose, high-fructose corn syrup, 'fruit juice concentrate', invert sugar, maltodextrin, dextrose, lactose, soluble or insoluble fibre, hydrogenated or interesterified oil . . . flavours, flavour enhancers, colours, emulsifiers, emulsifying salts, sweeteners, thickeners, and anti-foaming, bulking, carbonating, foaming, gelling and glazing agents."[44]

Defining UPFs on the basis of ingredients in this manner, researchers have documented how all consumers' diets in the U.S., not just kids', have shifted to include ever higher quantities of UPFs.[45] This increase may reflect what's available in the grocery store. As most food shoppers know, different retailers offer varying selections of UPFs and non-UPF foods.[46] These differences deserve analysis, and may present opportunities for public policy to influence the food supply in beneficial ways, as discussed in the policy recommendations section. The increasing prevalence of UPFs in our diets also reflects the addition of UPF ingredients to foods that previously fell in the "processed" (but not ultra processed) "Nova group 3" category, such as Girl Scout cookies.[47] Group 3 "processed foods" include "industrial products" made by adding salt, sugar or other culinary ingredients together, but without the ingredients that are "mostly of exclusive industrial use."

Concerns about excessive food "processing" predate the Nova classification scheme. For example, India's 1998 official dietary guidelines warned consumers to "judiciously" consume "processed and ready-to-eat foods."[48] However, the Nova classification system has coincided with heightened scrutiny into industrial food processing practices' impact on diet-related disease. The term "ultra-processed foods" first appeared in an official dietary guideline in Brazil in 2014. Since then, at least seven other countries' official dietary guidelines have advised citizens to limit "ultra-processed foods" or "highly-processed foods." Proponents of this language have argued that it is more informative than "nutrient-based messages"—e.g. "avoid foods high in saturated fat"—because individual nutrients in isolation are less relevant to disease risks than overall dietary patterns. Focusing on UPFs, rather than nutrients, also emphasizes the role of food producers and the food environment in contributing to obesity.[49]

Critics of the Nova system point out that UPFs represent a large and extremely varied category of foods, and that advice to avoid them may lead some consumers to make less healthy choices, waste food, or even contract a foodborne illness.[50] Particularly in today's food environment, a UPF often represents the most nutritious option available to a consumer. Moreover, many of the ingredients and processes that extend the shelf life of UPFs undoubtedly lower costs and put a healthier diet within reach of many consumers. But while UPF products' heterogeneity counsels in favor of a nuanced approach to dietary advice, policymakers should not ignore the evidence tying UPFs to disease. Rather, they should seek to increase public awareness of the harms associated with UPFs, and enact policies to reduce those harms.

B. Which ingredients signal a product is UPF?

The growing body of research on UPFs implicitly adopts the Nova classification definition, yet different researchers have employed different UPF definitions.[51] This has led to critiques that "'ultra-processed' is not a science-based term."[52] The Nova classification system's architects have countered that the definition depends on ingredients. Which ingredients? There are two classes: those that are "never or rarely used in kitchens," and those whose "function is to make the final product palatable or more appealing," i.e. "cosmetic additives."[53] Both categories contain edge cases. Some home cooks may keep a store of MSG in the pantry. Cosmetic "colorants" may include innocuous additions like paprika. Nevertheless, comprehensive lists of "characteristic" UPF ingredients show little variation from study to study.[54]

Relying on ingredients, rather than food descriptions, as some studies have done, results in a slightly larger proportion of popularly consumed foods falling into the UPF category.[55] Use of an app, such as "Open Food Facts," can help to illuminate the fault lines here.[56] An organic, plain yogurt, for example, may not seem like a UPF, but if it contains the emulsifier pectin, it sits in "category four" alongside Cap'N Crunch Oops All Berries breakfast cereal. Conversely, Boulder Canyon classic sea salt potato chips and Haagen Dazs Vanilla ice cream escape the UPF designation. The extent to which these cases pose a challenge may depend in part on one's view of why UPFs appear to harm human health.[57]

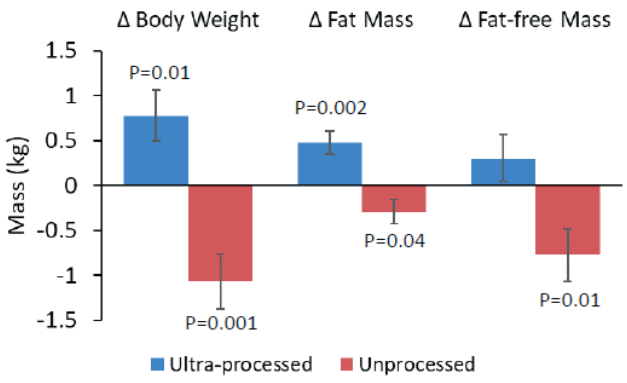
C. The evidence linking UPFs to disease

Before exploring the theories behind the "why," a review of the evidence linking UPFs to disease deserves mention. This body of evidence is growing rapidly and it leaves little room for doubt: a diet high in UPFs is associated with a range of maladies.

The largest body of research implicating UPFs in disease involves "observational" or "epidemiological" studies, that usually involve asking participants to fill out a survey about what they eat and tracking their health outcomes over time. Since 2009, according to one recent review, at least 45 unique pooled analyses—combining the results of epidemiological studies that included nearly 10 million participants—have sought to measure the effect of UPFs in the diet on health. These studies present "convincing and highly suggestive evidence" that eating more UPFs is associated with increased risk of an earlier death, cardiovascular disease, overweight and obesity, type 2 diabetes, and "common mental health disorders" like anxiety, depression and insomnia.[58] Another recent review of 10 observational studies analyzing nearly 1 million participants' diets and neurological disease found that "high" UPF consumption correlated with a significant increase in dementia risk compared to "moderate" or "low" UPF consumption after adjusting for age, socioeconomic status, co-morbidities, and other potentially confounding variables.[59] Similarly, in a longitudinal analysis of nearly 200,000 UK Biobank participants, over 15,000 of whom developed cancer during the study period, researchers estimated that every 10% increment in UPF consumption corresponded with a 6% increase in overall cancer mortality risk, a 16% increase in breast cancer mortality risk, and a 30% increase in ovarian cancer mortality risk.[60]

Again, correlation does not always signify causation. However, researchers have sought to control for confounding variables, such as lower fruit and vegetable consumption, and found that "associations between UPFs, obesity and health-related outcomes remain significant and unchanged in magnitude."[61] The one randomized clinical control trial of UPF consumption, moreover, strongly suggests that consuming ultra-processed foods, independent of macronutrient content, causes weight gain, pointing towards a mechanistic link between UPF and obesogenic effects.

That study was also spearheaded by Kevin Hall, of the Biggest Loser study discussed above. Hall was reportedly skeptical of the Nova classification system.[62] He designed a study in which 20 healthy adult volunteers stayed at an NIH facility for four weeks, randomly assigned to eat either an ultra-processed or minimally processed diet for two weeks, and then switched to the other diet for the remaining two weeks. The participants were served twice as many calories as needed to maintain their body weight, and told to eat as much as they liked. The UPF meals and snacks, which included items like Honeynut Cheerios, Chef Boyardee ravioli, Tyson steak strips, and Lay's Baked Potato Chips, were matched for total calories, energy density, macronutrients, fiber, sugar, and sodium with the "unprocessed" meals and snacks, which included items like frozen strawberries, chopped walnuts, steamed broccoli, Greek yogurt, and grilled chicken breast.[63]



Source: Hall, K. D. (2019). Ultra-processed diets cause excess calorie intake and weight gain: A one-month inpatient randomized controlled trial of ad libitum food intake. https://doi.org/10.31232/osf.io/w3zh2

Despite the study participants rating the UPF and non-UPF diets similarly, they ate a far higher number of calories (508) on the UPF diet. Participants gained an average 0.8 kg while on the UPF diet and lost 1.1 kh during the "unprocessed" diet. The researchers conclusion: "Limiting consumption of ultra-processed foods may be an effective strategy for obesity prevention and treatment."

IV. The leading theories on how UPFs may cause disease.

If UPFs indeed cause some of or all of the various diseases associated with their consumption, how do they do it? In other words, what are the mechanisms by which UPFs cause harm? Researchers have theorized several different ones, which implicate different ingredients and processes, along with different policy and educational responses.

The one randomized control trial study of UPFs, discussed above, points to one important mechanism: a high UPF diet leads to excess calorie consumption. This finding represents an important validation of the UPF concept. However, it raises a further line of questions as to why UPFs cause overeating. Indeed, Hall and his coauthors acknowledge that various factors—including slightly lower protein content in the UPF diet, use of fiber supplements in the UPF diets, and differences in the diets' "texture or sensory properties"—may account for the differences in eating behavior under the UPF and unprocessed diets in their study. Even greater uncertainty surrounds the mechanisms behind observed associations between UPFs and ailments less tied to weight gain, such as anxiety.

In fact, the evidence suggests that UPFs harm health in a variety of ways. Their soft texture and low fiber content, hyperpalatable design, and suggestive marketing, all appear to contribute to overeating. Additives like emulsifiers appear to compromise the microbiome. Others appear to alter hormone function. Chemical flavoring may interfere with the body's capacity to match foods with needed nutrients and satisfy hunger cravings.

Different aspects of how UPFs harm health may lead different consumers to tailor the strategies they choose to reduce their risk exposure from UPFs. For instance, the parent of a child with ADHD may seek to avoid a particular subset of UPFs, particularly those that contain many artificial dyes, while a consumer seeking to manage excess weight may care less about a UPF's additives and more about levels of salt, fat, and sugar. This understanding is important insofar as few of us are in a position to eliminate UPFs entirely from our diets. The following discusses some of the leading studies on the mechanisms behind UPFs' harms.

A. UPFs cause disease because they lead to excess calorie consumption.

As discussed, both the NIH clinical researchers and observational studies have found evidence that UPFs lead to overeating. As many commentators have pointed out, food companies have a basic financial incentive to sell more product, so the fact that consumers tend to consume excess calories on a high UPF diet should not come as such a surprise. But what about UPFs specifically causes us to overeat? Several UPF characteristics may share the blame, including UPFs' soft textures, lack of fiber, and other mechanical properties; their typical macronutrient content with high levels of salt, sugar and fat, often in combination; their "hyperpalatable" quality; and their potential to disrupt the flavor nutrient learning process.[64, 65]

1. UPFs' texture and modified food matrix lead to overeating.

Industrial processing tends to strip out the natural fibers from UPFs, creating a product that requires less chewing and travels through the gastrointestinal tract more quickly. This shorter transit time facilitates faster eating, and higher calorie intake before the body signals fullness. After eating, the softer character of UPFs tends to result in a faster rate of "gastric emptying"—whereby food leaves the stomach and moves further along the digestive tract. This results in a shorter duration of satiety or feeling of fullness.[66] Several studies lend credence to the idea that UPFs' typically soft textures and low fiber content fuel overeating.[67]

Critics of the Nova system point out that both UPFs and minimally processed foods may have "hard" or "soft" textures, and high or low fiber content. One recent experiment comparing calorie intake, among participants eating meals consisting of "hard" UPFs such as "breaded chicken breast" versus "hard"

unprocessed food (e.g. skinless chicken breast) and "soft" UPFs (e.g. instant mashed potatoes) versus "soft" unprocessed foods (e.g. actual mashed potatoes) found that the texture, rather than the "level of processing" drove differences in calorie intake.[68] In the researchers' words: "Results showed that meal texture, rather than processing level, accounted for differences in the amount of food (g) consumed within an ad libitum test meal." However, as the same researchers noted, UPFs tend to have "softer textures and higher energy density." In other words, "processing level" is often synonymous with texture and fiber content.

Researchers refer to texture as a "macrostructural" property of food, but differences in UPFs at the microstructural level, referred to as the "food matrix" may play an even more important role. The food matrix of many "category 1" or "unprocessed" foods tends to slow down and reduce the absorption of nutrients in those foods. For example, researchers have found that the "indigenous matrix of the almond cell wall" remains largely intact during digestion, meaning that fewer calories are "bio-accessible" to a consumer eating a roasted almond compared to say, a UPF made with almond oil.[69] Similarly, the food matrix of some traditional cheeses, such as cheddar, appears to result in lower LDL cholesterol levels among individuals who eat them as compared to those who eat an equivalent amount of saturated fats from butter or other "less structured" sources.[70] These nutritional differences between foods with seemingly "equal" macronutrient content lend support to the idea of focusing on foods and dietary patterns rather than "the single-nutrient approach."[71]

2. UPFs' high fat, salt, and sugar content causes overeating.

UPFs tend to have high levels of sugar, salt, and fat. Indeed, UPF critics often point to front-of-pack (FOP) labeling requirements adopted across the globe as an important strategy for reducing UPF-related harms. Those labels typically employ a traffic light or stop sign symbol to alert consumers to foods "high in" sugar, salt and fat. UPFs often have high levels of these macronutrients.[72] But so do many unprocessed foods. To what extent does the macronutrient content of UPFs explain their association with weight gain and disease?

UPFs' higher sugar and fat content would seem to present a straightforward mechanism for driving weight gain. These macronutrients are the hallmarks of energy-dense foods, and as discussed above, these foods lend themselves to overeating because they can be eaten faster. But some researchers go further in claiming that the combination of salt, fat, sugar, and other simple carbohydrates in many UPFs results in what they call "hyperpalatable foods." Notably, foods meeting the "hyperpalatable" definition include many items that are not UPFs, including cheese.[73] According to these researchers, the macronutrient combinations in so-called "hyperpalatable foods," including many UPFs, "do not occur in nature," and so we "may not be evolutionarily prepared to handle" them.[74] The next section explores the notion of "hyperpalatability" further and characteristics inherent in UPFs that might contribute to these concerns.

UPFs may present unique concerns with respect to macronutrients insofar as ultra-processing enables the delivery of particularly high levels of salt, sugar, and fat. Sodas like Coca-Cola, for example, would taste "sickly sweet" if their high loads of sugar were not coupled with the sourness of phosphoric acid, a chemical extracted from rocks that causes tooth decay and osteoporosis.[75] Soda companies and other UPF manufacturers have an incentive to pack lots of sugar into their products, however, because the resulting spike in glucose stimulates neurons in the gut and brain that create deep-seated cravings and positive associations with their brands.[76] Of course, a home chef similarly wants to prepare foods that are craved, or at least garner a positive association. However, the industrial processes that characterize UPFs, along with corporate financial incentives to sell ever more product, increase the potential for mischief.

3. Other "hyperpalatable" qualities of UPF cause overeating.

Many researchers insist that nutrient content alone cannot account for UPF's "hyperpalatability."[77] This makes sense considering UPF manufacturers' financial incentives to sell more products. With some exceptions (e.g. preservatives), the characteristic ingredients of UPFs all serve to make products more "craveable," to use the industry jargon.[78] Along with marketing and design, flavors, flavor enhancers,

colorants, non-sugar sweeteners, emulsifiers, thickeners, and various other UPF additives conspire to hijack the brain's reward circuitry and leave the consumer craving more.[79] Neurologists argue that UPFs evoke not so much a "pleasure" response as a "wish" response to increase consumption. "Mindful eating" exercises—whereby individuals carefully observe the sensory experiences that arise as they see, smell, taste, chew, and swallow a given food—can help to "break the spell" of the "wish" response that UPFs stimulate.[80] Under the typical, rushed eating conditions of most modern consumers, however, UPF's "craveability" can easily lead to overconsumption.

As with other substances consumed to excess, UPFs appear to generate higher tolerances among heavy users.[81] This may explain why eating more UPFs correlates with binge eating disorder risk.[82] Indeed, some researchers have sought to operationalize the concept of "UPF addiction," pointing out that UPFs exploded in popularity after tobacco companies acquired many of the largest UPF manufacturers (e.g., Kraft, General Foods) in the 1980s and applied their special expertise to make UPF consumption optimally "reinforcing."[83]

UPFs' hyperpalatable character and related addiction potential raise special concerns with respect to children. In a recent prospective study involving 1,175 children, four-year-olds that ate more UPFs had more "fussy eating" habits three years later, likely resulting from a "negative feedback loop," according to the researchers, in which UPF consumption led to less tolerance for other foods, leading to more UPF consumption, leading to ever pickier eating.[84] Neuroimaging studies have shown that when children view unhealthy foods, they experience activation in brain regions implicated in reward and cognitive processes that also tend to be most affected in patients with eating disorders.[85] This neurological fingerprint helps to explain recent estimates that 15% of youths suffer from a UPF addiction.[86]

4. Additives in UPFs disrupt normal "flavor-nutrient learning" processes.

Yet another mechanism by which UPFs may cause overeating is by delinking flavors to their host foods and nutrients. This theory relates to how humans have learned to connect foods' taste and feel with how they affect the body across the course of our evolution. So-called flavor-nutrient learning progresses more rapidly with novel foods, and young children are particularly impressionable.[87] But to some extent, whenever an individual eats a food and the body responds to it, flavor-nutrient learning takes place.[88] Until recently, this process has enabled people to match the taste and feel of a given food—e.g. a strawberry—with that food's nutrient profile. This allows someone to seek out foods that correspond to their body's nutritional needs. UPFs may disrupt the flavor-nutrient learning process, however, resulting in excess calories and weight gain.

Researchers have theorized that added flavors, a characteristic UPF ingredient, may drive these disruptions. Unlike flavors inherent in foods, added flavors—including so-called "natural flavors"—fail to provide a consistent nutrient signal. One strawberry's nutrient profile fairly resembles another strawberry's, notwithstanding differing varietals and growing conditions. This consistency supports the brain's and gut's ability to correctly predict how much food to eat to acquire the needed nutrients. By contrast, manufacturers may add "strawberry flavor" to a range of UPFs with widely disparate nutrient contents. Depending on the individual's eating history, the taste and feel of a "strawberry-flavored" food may create an expectation of nutrients that are not actually contained within the food, disrupting flavor-nutrient associations and causing uncertainty in the body. This uncertainty leads to "compensatory overeating"; as an individual's capacity to predict the nutrients within a food deteriorates, the individual eats more to increase the odds of acquiring sufficient nutrients.[89]

Added flavors are not the only UPF ingredients implicated in "compensatory eating." Neuroimaging studies have shown a complex interaction between a food's "sweetness" and its caloric load on "metabolic response," or changes in blood sugar. Artificial sweeteners, but also flavorless calorie sources like maltodextrin, may increase many UPFs' "reinforcement potency."[90] According to one analogy, the consumer of UPFs comes to resemble the driver of a car with a broken gas gauge, condemned to "fill up" more often than necessary to avoid getting stranded on the highway.[91]

B. UPFs cause disease by degrading the microbiome.

Trillions of bacteria, more than the total number of cells, live in the human body.[92] Collectively known as the microbiome, these microorganisms play a critical role in digestion, healthy metabolism, and even immunity to diseases.[93] In animal studies, scientists have shown that a microbiome transplant from a skinny mouse to an obese one can result in weight gain, and vice versa.[94] Large epidemiological studies, in turn, have shown that diet determines the gut microbiome's make-up to a large extent.

Among other important roles, the gut microbiome helps to maintain a barrier—the "mucosal layer"—in the small intestine that facilitates nutrient absorption while keeping bacteria from escaping the intestines. When this mucosal layer or "gut barrier" breaks down, the resulting "leaky gut" is hypothesized to cause irritable bowel syndrome and other illnesses.

Proponents of the Nova system have raised concerns about one class of UPF ingredients in particular—emulsifiers—due to their potential to compromise the microbiome and the gut barrier in particular.[95] Food manufacturers rely extensively on emulsifiers to give texture and prolong the shelf life of processed foods. They may derive these additives from natural (e.g. lecithins) or synthetic sources (e.g. polysorbates, sorbitans, methylcellulose).[96] While the U.S. FDA has approved 171 emulsifiers and emulsifying salts, just 63 emulsifying agents are approved for use in food in the European Union.[97]

Studies suggest that even low concentrations of some synthetic emulsifiers may affect gut health.[98] For example, a randomized feeding trial with 16 subjects observed over 11 days, found that subjects eating foods that contained the common synthetic emulsifier carboxymethyl cellulose experienced an increase in stomach discomfort, a decline in gut bacteria diversity, and increased gut inflammation compared to subjects who were fed the emulsifier-free control diet.[99] Similarly, an in vitro study found that low concentrations of polysorbate-80 led to an increased capacity of Escherichia coli bacteria linked with Crohn's disease to invade gut epithelial cells.[100]

Other studies suggest that an emulsifier's natural or synthetic origins may matter less than the additive's "emulsifying strength." One recent in vitro study, for example, measured the response of gut microbiota isolated from ten human subjects to carboxymethylcellulose (CMC), polysorbate 80P80, soy lecithin, sophorolipids, and rhamnolipids (RLs) at various concentrations. The researchers found that the "natural" emulsifiers damaged gut microbiota more than the synthetic at equivalent concentrations, but that all of the additives' impacts increased with dose, with the "decline in intact microbial cell counts" observed in the study "comparable to what has been observed for antibiotic treatments."[101] In other words, some common UPF additives may kill off gut microbiota in a manner similar to taking a course of antibiotics to fight an infection. These effects, coupled with UPFs' increasing prominence in the American diet, may help to explain rising rates of inflammatory bowel disease, which now affects up to 3.1 million adults, at a cost of $8.5 billion in annual healthcare costs, according to the CDC.[102]

C. UPFs contain chemicals that interfere with the body's hormones.

So-called endocrine-disrupting chemicals (EDCs) interfere with the body's hormone or endocrine system, and some public health advocates cite them as another reason to avoid UPFs.[103] EDCs include over 1,000 synthesized chemical compounds, and can affect a wide range of organs and tissues involved in metabolism.[104] Plastics like bisphenol A (BPA) and plasticizers like phthalates are among the most frequently cited in connection with food, and may pose particular harm to children.[105] Researchers have documented how many EDCs can act as so-called "obesogens" by increasing white adipose cells, impairing appetite regulating hormones, and causing glucose intolerance and hyperinsulinemia.[106] The evidence suggests EDCs compromise public health both by affecting individuals directly, and by inducing epigenetic changes that increase future generations' susceptibility to diseases like diabetes and obesity.[107] These intergenerational impacts may explain, in part, obesity rates' continued climb despite dietary improvements, such as falling sugar sweetened beverage consumption,[108] and increases in physical activity.[109]

Cutting down on UPFs may help to reduce exposure to certain EDCs. Researchers have found that

Examples of Product Reformulation Abroad

Haribo Goldbears in the United States

Ingredients: Glucose syrup (from wheat or corn), sugar, gelatin, dextrose (from wheat or corn), contains less than 2% of: citric acid, artificial and natural flavors, sunflower oil, white beeswax, yellow beeswax, **yellow 5, red 40, blue 1**.

Haribo Goldbears in France

Ingredients: glucose syrup; sugar; gelatin; dextrose; concentrated fruit juices: apple, raspberry, strawberry, orange, lemon, pineapple; acidifier: citric acid; sunflower oil; **fruit and plant concentrates: safflower, spirulina, apple, elderberry, orange, blackcurrant, kiwi, lemon, aronia, mango, grape, passion fruit**; flavouring; elderberry extract; coating agent: white and yellow beeswax.

Skittles in the United States

Ingredients: Sugar, Corn Syrup, Hydrogenated Palm Kernel Oil; Less Than 2% Of: Citric Acid, Tapioca Dextrin, Modified Corn Starch, Natural And Artificial Flavors, **Colors (Red 40 Lake, Yellow 5 Lake, Blue 2 Lake, Yellow 6 Lake, Titanium Dioxide, Blue 1 Lake, Yellow 6, Red 40, Yellow 5, Blue 1)**, Sodium Citrate, Carnauba Wax.

Skittles in the United Kingdom

Ingredients: Sugar, glucose syrup, palm fat, acids, citric acid, malic acid, dextrin, maltodextrin, flavourings, modified starch, **colours: beetroot red, Anthocyanins, Calcium carbonate, carotenes, curcumin, indigotine, brilliant blue**, acidity regulator trisodium citrate, glazing agent carnauba wax.

diets higher in UPFs correlate with higher urinary concentrations of various EDCs, possibly because of contamination from packaging materials.[110] What accounts for these correlations, however, remains somewhat of a mystery. After testing dozens of food items for BPA and phthalates, researchers at Consumer Reports theorized that fast food workers' gloves may have accounted for the highest levels of plasticizer contamination detected, found in products like Wendy's crispy chicken nuggets and Moe's Southwest Grill chicken burrito.[111]

Of course, workers may use these gloves to prepare other, non-UPF foods. More generally, critics argue that environmental exposures to EDCs "likely dwarf" UPFs' contribution to the overall burden.[112] Indeed, sources as varied as cosmetics, toys, carpets, pesticide residues on foods, and even the ambient air and water may contribute significantly to the EDC burden on a typical consumer.[113] Food production equipment—including equipment used to produce less processed food—may contain EDCs as well. That was the source hypothesized to drive the "unexpected results" in a dietary intervention study in which ten families ate a strictly controlled diet free of UPFs for five days, only to find that their urinary EDC concentrations had increased at the study's conclusion.[114]

Needless to say, reducing exposure to EDCs will require policies and personal choices that go beyond UPFs. However, while dietary changes may not suffice to avoid ubiquitous EDCs like phthalates and BPA, some common UPF additives also appear to act as EDCs. To cite just one example, the preservative butylated hydroxyanisole (BHA) may cause thyroid system damage, metabolic and growth disorders, neurotoxicity, and carcinogenesis.[115] These concerns have led European Union regulators to ban BHA in food, a move that some state legislators in New York[116] and Pennsylvania[117] seek to follow. Currently in the United States, some 4,668 foods on store shelves contain BHA, according to USDA's "Branded Foods database."

D. Additives in UPFs interfere with healthy brain development.

Researchers have documented an association between UPF consumption and various mental illnesses including attention-deficit disorder.[118] Evidence linking one class of UPF additives in particular—artificial food coloring—to neurological health disorders has grown considerably in the decades since these dyes came on to the market.[119] Manufacturers use artificial food colorings in thousands of products, particularly those marketed to children, to enhance their appeal.[120] As early as 1975, medical experts hypothesized that the dyes may cause attention problems in children.[121] Following two large clinical trials in the 2000s that lent support to this hypothesis, as well as animal and other studies that shed light on the mechanisms by which the dyes cause neurological harm, the European Union enacted a warning label requirement for foods containing artificial dyes.[122]

The EU warning label law in effect.

The European law requires manufacturers to warn consumers that food dyes "may have an adverse effect on activity and attention in children."[123] However, most food manufacturers have opted to reformulate their product rather than risk scaring off consumers with accurate information. Companies including McDonald's, Nestlé, Kraft, Mars, Haribou, and Kellogg all sell products free of artificial dyes in the United Kingdom that contain the additives in the U.S.[124]

The FDA approved the banned food dyes between 1969 and 1987.[125] On its website, the agency main-

Examples of Product Reformulation Abroad

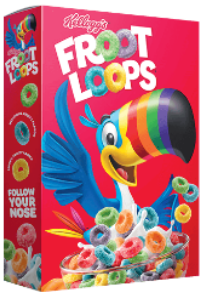
Fanta in the United States

Ingredients: Carbonated water, high fructose corn syrup, less than 2% of: citric acid, natural flavors, sodium benzoate (to protect taste), modified food starch, glycerol ester of rosin, **yellow 6, red 40**

Fanta in the United Kingdom

Ingredients: Carbonated Water, Sugar, Orange Juice from Concentrate (3.7%), Citrus Fruit from Concentrate (1.3%), Citric Acid, **Vegetable Extracts (Carrot, Pumpkin)**, Sweeteners (Acesulfame K, Sucralose), Preservative (Potassium Sorbate), Malic Acid, Acidity Regulator (Sodium Citrate), Stabiliser (Guar Gum), Natural Orange Flavourings with other Natural Flavourings, Antioxidant (Ascorbic Acid).

Froot Loops in the United States



Ingredients: Corn Flour Blend (Whole Grain Yellow Corn Flour, Degerminated Yellow Corn Flour), Sugar, Wheat Flour, Whole Grain Oat Flour, Modified Food Starch, Contains 2% Or Less Of Vegetable Oil (Hydrogenated Coconut, Soybean And/Or Cottonseed), Oat Fiber, Maltodextrin, Salt, Soluble Corn Fiber, Natural Flavor, **Red 40, Yellow 5, Blue 1, Yellow 6**, Bht For Freshness. Vitamins And Minerals: Vitamin C (Ascorbic Acid), Reduced Iron, Niacinamide, Vitamin B6 (Pyridoxine Hydrochloride), Vitamin B2 (Riboflavin), Vitamin B1 (Thiamin Hydrochloride), Folic Acid, Vitamin D3, Vitamin B12.

Froot Loops in Germany

Ingredients: Cereal flours (79%) (Wheat,Oats, corn), sugar, glucose syrup, salt, fruit and **vegetable concentrates (carrots, cherries)**, natural citrus flavour with other natural flavours, **colour (carotene)**.

tains that "most children have no adverse effects when consuming foods containing color additives, but some evidence suggests that certain children may be sensitive to them."[126] However, a 2021 report by the California Office of Environmental Health Hazard Assessment concluded that "neurobehavioral effects of synthetic food dyes in children should be acknowledged and steps taken to reduce exposure to these dyes in children."[127] California's Food Safety Act banned red dye 3, along with three other food additives, and other states may soon follow suit with their own bans on artificial dyes.[128]

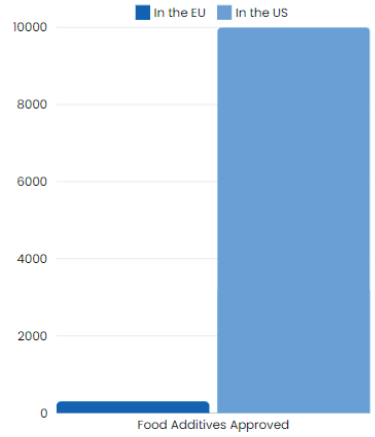
V. Policy solutions to reduce UPF harms

Already, some state and local leaders have implemented UPF specific policies, such as rules limiting "highly processed" foods in meals served in school and daycare settings.[129] Federal policy, however, has yet to acknowledge "processing" as a relevant consideration in dietary guidance or food programs. That should change. Policymakers have many tools for educating consumers about UPFs—from official dietary guidelines to labeling requirements. Providing accurate information to counter the billions spent on food marketing should figure prominently into any public nutrition policy.

But consumers should not have to bear all the responsibility for avoiding the hazards that UPFs present. Regulators must improve the food chemical oversight system. Recent state-level legislation, including California's ban of four food additives, attests to consumer demand for more protections from UPF harms. Federal regulators at FDA and USDA, however, are better positioned to investigate UPF harms and protect consumers while minimizing unnecessary disruptions to the food system. Federal policy should also promote access to UPF alternatives, including by fostering competition in the food system, by leveraging food assistance programs to promote healthy alternatives to UPFs, by protecting children from manipulative junk food marketing online and elsewhere, and by taxing the most harmful category of UPFs: soda. The following elaborates on these ideas.

A. Require independent, rigorous review of food chemical safety

Most of us tend to understand that foods high in sugar, salt, and fat should be eaten in moderation. But we rely on experts to determine whether chemical additives in food pose a safety concern. In the United States, the United States Food and Drug Administration ("FDA") has the primary responsibility for providing this assurance, but the agency has not fulfilled its duty. Experts estimate that food companies have "self-certified" the safety of over a thousand novel food ingredients without even notifying FDA.[130] These ingredients may enter the food supply under the guise of opaque labeling terms like "natural flavor," or "spices," with neither FDA nor the public aware of the addition. And even for known ingredients, when safety concerns emerge, FDA lacks the resources and authority to conduct adequate post-market evaluations.



Data from *Food additives*. (2024, March 19). European Food Safety Authority. https://www.efsa.europa.eu/en/topics/topic/food-additives and Neltner, T. G., Kulkarni, N. R., Alger, H. M., Maffini, M. V., Bongard, E. D., Fortin, N. D., & Olson, E. D. (2011). Navigating the U.S. Food Additive Regulatory Program. *Comprehensive Reviews in Food Science and Food Safety, 10*(6), 342–368. https://doi.org/10.1111/j.1541-4337.2011.00166.x

Recently, states have begun stepping into the regulatory void left by FDA. In 2023, California enacted the California Food Safety Act, which bans brominated vegetable oil ("BVO"), potassium bromate, propylparaben, and red dye 3 in foods.[131] All of these chemicals have long been subject to bans in Europe and other countries across the world.[132] California's law has helped to bring attention to the outlier status of U.S. rules, and may have already succeeded in catalyzing reform at FDA. Just weeks after the California bill was signed into law, FDA announced that it would ban BVO.[133] Food companies, wary of a patchwork regulatory system across the states, may support stronger chemical oversight if more bills like California's pass. However, change will not come easy. Meaningful oversight of food chemicals at FDA will require both legal and regulatory

reforms that give the agency access to information on ingredients' safety, and the resources to evaluate that information.

1. Close the GRAS loophole

As a first step, FDA should close the loophole that has allowed companies to self-certify the safety of many chemical ingredients in food, without even notifying regulators. Over half a century ago, Congress passed the Food Additives Amendment of 1958 (FAA) to ensure the safety of novel chemicals in the food supply.[134] The law directs FDA to conduct a pre-market safety evaluation of all food additives. However, Congress carved out an exemption for familiar substances like vinegar and baking soda that were deemed "Generally Recognized as Safe," or GRAS.[135] In the years since, the GRAS loophole has expanded to create an opaque self-certification system that has largely displaced FDA's oversight role. The GRAS loophole has critically weakened the agency's capacity to monitor additives in the food supply. As a result, the agency cannot calculate consumers' cumulative exposure to food chemicals of concern.

Under the law, an ingredient is GRAS if its condition of use is safe, and the safety of that use is generally recognized by scientists knowledgeable about the safety of substances added to food.[136] FDA has interpreted this provision to allow a food company to rely on its own, in-house expertise to determine an ingredient's safety. The company need not even notify FDA that it has made a GRAS determination. When companies have voluntarily submitted their GRAS evaluations to FDA, the records have revealed widespread conflicts of interest, with company employees and paid consultants typically responsible for flagging safety concerns.[137]

The GRAS loophole has attracted criticism for decades. In 2010, the Government Accountability Office (GAO) recommended that FDA should require companies to provide "basic information" about GRAS determinations, including "the substance's identity and intended uses," and to make that information public. As the GAO pointed out, FDA cannot ensure the safety of food ingredients that it does not know about. The GAO also recommended standards to address conflicts of interest in GRAS determinations, and systemic reconsiderations of GRAS substances' safety by FDA.[138]

FDA has yet to act on GAO's recommendations. But here again, encroachments by state regulators may rouse the federal agency to action. A bill introduced in the New York state legislature takes aim at so-called "secret GRAS." If passed, "S08615/A9295" would require companies to disclose to state regulators the presence of chemical additives in foods that a company has self-determined as GRAS without notifying the FDA. Such laws will increase visibility into the chemicals that currently pervade the food supply. They may reveal health concerns that conflicted GRAS panels have neglected to account for. And by raising awareness of how much we do not know about what's in our food, they may help persuade FDA and Congress to act.

2. Reassess the safety of food chemicals on the market

Even if FDA closed the GRAS loophole today, chemical additives already allowed in food raise important safety concerns. Many ingredients, such as artificial dyes, underwent FDA review decades ago. FDA needs to systematically reassess the safety of these ingredients. Representative Jan Schakowsky has introduced a bill, the "Food Chemical Reassessment Act," that would start such a process. The bill requires FDA to evaluate at least ten food additives every three years, starting with a list of substances whose safety has been widely questioned.[139]

As alluded to earlier, one of these substances, brominated vegetable oil (BVO), will no longer appear on food ingredient lists as of August 2025, thanks to a recent FDA action to revoke its approval of BVO as food additive.[140] FDA has also recently signaled its intention to reevaluate a broader list of food additives,[141] and the head of a newly reorganized Human Foods Program has acknowledged that "Americans expect the FDA to be doing more in this area."[142] The creation of an Office of Food Chemical Safety, Dietary Supplements, and Innovation, is intended to "modernize and strengthen oversight of food chemical safety."[143] However, only time will tell whether this new office accomplishes that mission, and critically, whether Congress will adequately fund it.

B. Increase funding for research on UPFs

Critics and adherents alike of the Nova classification scheme vehemently agree on one point: not

enough research has examined the health effects of diets with varying levels and types of UPFs. More nutrition research funding could help to shed light on why high UPF consumption correlates with so many disease outcomes. Yet funding for nutritional research pales in comparison to other areas. In 2023, the National Institutes of Health (NIH) Office of Nutrition Research operated on a $40 million budget.[144] Overall, the NIH invested just over $2 billion on nutrition research, including grants to outside scientists at universities. By contrast, NIH spent $7.3 billion for cancer research, $11.9 billion on neuroscience, $8.9 billion on brain disorders, and $5.1 billion on neurodegenerative diseases.[145]

As diet-related disease has soared, federal funding for nutrition research has failed to keep up. Following Kevin Hall's groundbreaking study comparing UPFs to nutritionally equivalent foods, NIH actually proposed closing the metabolic research unit that made the study possible.[146] Today, Hall is able to use just two beds in the ward, meaning his next study will take years to complete.[147]

Skimping on public funding for nutrition research is a pennywise pound-foolish strategy. Industry funded research does not produce reliable evidence so much as marketing materials.[148] To advance understanding of the specific mechanisms by which ultra-processed foods affect health, disinterested researchers will need to devote considerable time, energy, and resources into investigating the various theories discussed above. Funding to support this research should yield a high return considering the overwhelming and growing burden of diet-related diseases, the ubiquity of UPFs in the U.S. food system, the strong association between UPFs and disease, and the uncertainty surrounding why UPFs seem to cause so much illness.

C. Educate consumers about ultra-processed foods.

Federal policy has played a profound role in shaping how U.S. consumers understand food. For decades, official dietary guidance has emphasized a "single nutrient" approach that oversimplifies dietary choices.[149] By acknowledging the important role that processing plays in the diet, federal policymakers can help to shift the emphasis away from single nutrients and towards broader dietary patterns. Policies such as labeling requirements, moreover, can help consumers to identify and avoid UPFs.

1. Include a UPF definition and recommendation to reduce consumption in the Dietary Guidelines for Americans.

Every five years, federal officials release a new edition of the Dietary Guidelines for Americans ("DGAs"), intended to "provide[] advice on what to eat and drink to meet nutrient needs, promote health, and prevent disease."[150] An expert committee, the Dietary Guidelines Advisory Committee, evaluates the latest research, along with comments from the public, in response to a series of questions assigned to it by USDA and HHS officials. The Committee then makes recommendations on any changes needed to the DGAs.

The current DGAs are due to be updated next year, in 2025, and the advisory committee for the 2025-2030 DGAs is considering, among other questions: "What is the relationship between consumption of dietary patterns with varying amounts of ultra-processed foods and growth, body composition, and risk of obesity?" In their public meetings, the advisory committee members have expressed reluctance to single out UPFs.[151] The committee did not formally consider the one clinical trial examining the impact of eating UPFs, discussed above, because it did not last long enough to meet the federal agencies' parameters. However, based on the observational data, the committee presented a conclusion statement that at least "limited evidence" suggests that high UPF diets "are associated with greater adiposity," i.e. fatness.

Should USDA and HHS officials choose to integrate "processing" as a variable to consider in the next DGAs, the U.S. will join nearly a dozen other countries with recommendations to limit UPFs or "highly processed" foods.[152] These guidelines sometimes acknowledge that UPFs may deliver some beneficial nutrients, but emphasize that less processed options usually represent a healthier choice. In general, they counsel consumers to avoid UPFs where possible. Belgium's guidelines, for example, define classes of "food groups to limit," such as "beverages with added sugars" and "sugar-sweetened products," in part based on "level of processing." They provide the Nova definition of UPFs and explain that "[m]ost ultra-processed foods should by no means replace

basic foods," despite the fact that "some ultra-processed foods may have an acceptable nutritional quality or beneficial nutritional density."[153]

The DGAs could take a similar approach. Acknowledging the evidence linking UPFs to chronic illness could help many consumers make healthier choices, and clear up some of the confusion surrounding UPFs. According to a recent survey of the industry-funded International Food Information Counsel, 7 in 10 Americans "say they do not fully understand or could explain what a processed food is."[154] This uncertainty reflects in part the multitude of schemes competing to define what "processed" means. Already, by defining the health impacts of "ultraprocessed foods" as a research objective to inform the next DGAs, federal regulators have taken an important step towards validating the Nova classification scheme. Some researchers have sought to build on the Nova scheme, or displace it, with alternative definitions of "processed" or even "ultraprocessed" food.[155] However, the vast majority of research on UPFs employs the Nova definition, consistent with the terminology's origin. So a recommendation to limit UPFs in the diet, or even just recognizing the link between diets high in UPFs and disease, would help to further build a shared vocabulary around the "ultraprocessing" concept.

Including UPFs in the DGAs could lead to more concrete policy changes as well. The DGAs play an important role in determining school meal content. Serving around 5 billion lunches and 2.4 billion breakfasts each year, the federal school meal program provides many students with their main source of calories. The current guidelines' focus on individual nutrients, without regard for processing and additives, has led providers to rely on ingredients like non-nutritive sweeteners to meet stricter nutrition standards.[156] Under these standards, many school districts settle on foods like Lunchables, Cheez-Its, and sugary breakfast cereals.[157] In addition to compromising the diet quality of school children today, these arrangements set the foundation for a lifetime of unhealthy food associations.[158] Recognizing the science linking diets high in UPFs to disease would enable secretaries of health, agriculture, and defense to begin taking steps to reduce exposure and incentivize industry to develop healthy alternatives.

2. Require front-of-pack labeling to help consumers distinguish UPFs.

Requirements to post nutrition information on the front of food packaging—so-called "front-of-pack" or FOP labeling rules—are a preferred tool among public health advocates seeking to reduce UPFs' ill effects.[159] Several countries have adopted FOP labeling rules that help consumers identify products "high in" salt, sugar, or fat. Some European countries integrate nutrition information into a single metric that runs from most ("A") to least ("E") healthy.[160] These schemes indirectly target UPFs, which often contain high levels of salt, sugar, and fat, but policymakers have also proposed labeling UPFs directly.[161] Finally, FDA could define a new claim—e.g. "certified less processed"—that manufacturers and food sellers could use to signal when foods are not UPFs. The following discusses some of the pros and cons of these approaches.

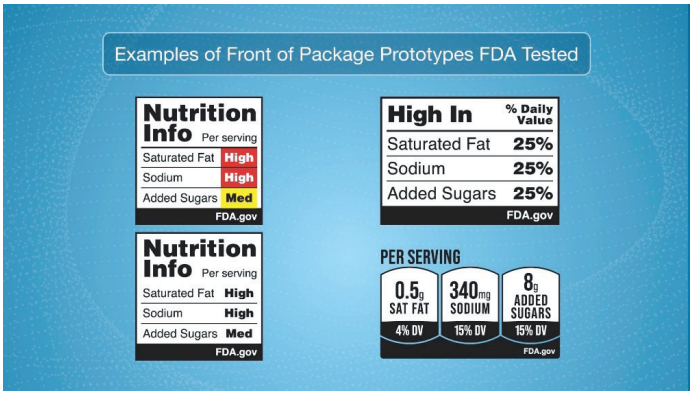
i. FDA's proposed FOP labeling requirements

The United States nutrition and ingredient labeling laws once led the way, but the country has since become exceptional for failing to require food manufacturers to warn consumers about "high in" foods with high levels of salt, sugar and fat on the front of package labels. Studies show that FOP labeling systems nudge consumers towards healthier products, and may deter consumption of UPFs, which tend to also be "high in" foods.[162] For over a decade, advocates have rallied around a proposal for a single, standardized "high in" labeling system that can be understood by most age groups, as endorsed by the Institute of Medicine.[163]

While U.S. officials have dithered, countries around the world, particularly in the Americas, have adopted their own FOP labeling requirements. In Chile, black warning labels shaped like octagonal stop signs have alerted consumers to "high in" foods since 2016. Researchers have found that Chile's scheme resulted in decreased purchasing of HFSS products including a 36.8% reduction in sugar, a 21.6% reduction in sodium, and a 15.7% reduction in saturated fat.[164] These reductions reflect both shifts in consumer behavior and industry efforts to reformulate UPFs to lower levels of the "high in" nutrients.[165] Columbia, Peru, Argentina, Venezuela, Mexico, and Uruguay have since followed Chile's "stop sign" example, and Canada has begun im-

plementing its own "high in" labeling requirements, leaving the U.S. and Paraguay as the only major nations in the Western hemisphere without FOP labeling requirements.[166]

That may soon change. The Biden Administration has cited FOP labeling rules as a priority in its National Strategy on Hunger, Nutrition, and Health, with an emphasis on reaching consumers with "lower nutrition literacy."[167] FDA leaders have promised new rules by the end of 2024.[168] For their part, food industry lawyers have signaled that they may challenge the legal basis for the rules, under both the Food, Drug & Cosmetic Act and the First Amendment.[169] A judicial ruling in their favor would overrule broad public support for new labeling rules, which surveys show extends across demographic groups and political affiliations.[170]



Notably, FOP labeling provides little incentive for food manufacturers to rely on fewer additives in UPFs. In fact, some manufacturers, seeking to dodge a "high in" warning label, may reformulate products to replace excessive salt, sugar and fat with chemical additives that raise their own concerns, such as monosodium glutamate, non-nutritive sweeteners, and emulsifiers. Such "regrettable substitutions" have affected school children, for example, as meal providers increasingly rely on artificial sweeteners to meet new USDA added sugar limits.[171] This has led some researchers to suggest labeling requirements both for "high in" foods and those containing certain characteristic UPF ingredients, such as non-nutritive sweeteners or added colors and flavors.[172]

ii. An "ultra-processed food" warning label?

Earlier this year, U.S. Senators Bernie Sanders, Cory Booker and Peter Welch introduced "The Childhood Diabetes Reduction Act." Among other provisions, the Act would require a warning label on UPFs that reads "Food and Drug Administration Warning: Consuming ultra-processed foods and drinks can cause weight gain, which increases the risk of obesity and type-2 diabetes." The Act would task FDA with defining UPFs, either consistent with the Nova classification system or in some other manner.

No matter how FDA sought to define UPFs, food manufacturers would almost certainly challenge a warning label requirement, and regulators would have to grapple with nettlesome "edge cases." Under Nova, for example, products with "colorants" are ultra-processed, but an otherwise innocuous ingredient, such as paprika, may serve a "colorant" purpose. So if paprika is listed as a "colorant" or "for color," etc., on a product's ingredient list, then the product falls into the UPF category. Otherwise, it may not. More generally, determining the list of additives that trigger UPF status for the purposes of a warning label would invite intense opposition from food manufacturers, and set the stage for challenges under the First Amendment claiming that the underlying warning is not "purely factual and uncontroversial."[173] Despite this complexity, or perhaps because of it, a rulemaking process to define an "ultra-processed food" labeling requirement could serve an important educational function in itself.

iii. A voluntary "certified less processed" label?

Instead of requiring a warning label on UPFs, FDA could create a standard for labeling claims that manufacturers could use to signal that a product is not a UPF. FDA has the authority to define terms like "natural" and "healthy" on food products. For years, the agency has conducted research on a "healthy" symbol "that industry can voluntarily use to label food products that meet the proposed 'healthy' definition."[174] Consumer Federation of America and other advocates have objected to the agency's efforts to develop such a symbol, which would likely create confusion and lead some consumers to choose packaged (and thus labeled) products over comparatively healthier unpackaged goods, like fresh produce.[175] Nevertheless, a "less processed" symbol could help to level the playing field for processed food manufacturers that rely on simpler, and often more expensive, ingredients. It

could also serve to clear up an area of genuine confusion for many consumers.

As a starting point, FDA could propose a "less processed" claim to apply to all foods that do not contain any characteristic UPF ingredients, as defined under the Nova classification. Product manufacturers and other stakeholders could present evidence in support of alternative definitions through the rulemaking process. If an ingredient met certain public health criteria, such as evidence that its associated health benefits outweigh its hazards, FDA could choose to allow it in foods labeled "less processed" (or under some other nomenclature). The initiative could allow food regulators to leverage growing interest in UPFs to educate consumers and create incentives for food manufacturers to drop unnecessary additives.

iv. A warning label for foods containing artificial dyes

Given the evidence linking artificial dyes to neurological problems in children, including attention deficit and hyperactive disorder (ADHD), state and federal policymakers should consider following the European Union's example and requiring a warning label on foods containing these additives. In California, where state public health regulators have concluded that these dyes pose a health risk, over 70 percent of respondents to a recent survey supported mandatory warning labels on dyed foods.[176]

Consumer advocates have petitioned the California Department of Public Health to act under its existing authority and require the following warning on foods with Yellow 5, Red 40, Blue 1, Blue 2, Green 3, Red 3, Yellow 6, and the rarely used Orange B: "WARNING: Product contains synthetic food dyes which the State of California has determined can result in hyperactivity and other neurobehavioral problems in some children."[177] Despite only applying to foods sold in California, such a requirement would likely lead manufacturers to abandon these chemicals and reformulate their products, as many have already for the European market.[178]

v. Filling in the gaps—labeling requirements online and for alcohol

If consumers are to rely on ingredient labels to avoid UPFs or additives of concern in UPFs, those labels should be available on all food and beverage products, wherever they are sold. This includes online. Industry analysts predict that by 2026, over 160 million Americans will buy at least some of their groceries online.[179] Yet many food retailers, including some of the largest such as Walmart and Instacart, fail to reliably include ingredient and nutrition facts information online.[180] FDA can address these omissions with simple guidance clarifying online vendors' responsibilities.

Labels on alcoholic beverages, unlike soda, are not required to disclose ingredients

Consumers should also have access to ingredient lists for alcoholic beverages, which supply a significant proportion of the calories in many American diets. For decades, the agency that regulates labeling on most alcoholic beverages—the Department of Treasury's Alcohol and Tobacco Tax and Trade Bureau (TTB)—has dragged its feet in responding to a 2003 petition from consumer groups. In response to a lawsuit seeking to force the agency's hand, officials in 2023 promised the long-delayed rules within a year, only to announce that they would go back to the drawing board with a series of public meetings at the beginning of 2024.[181] In the meantime, consumers remain in the dark about the additives contained within any given beer, wine or spirit.

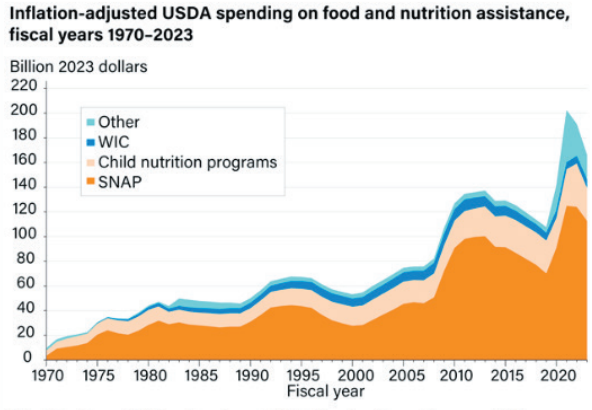
A&W Root Beer and Newcastle Brown Ale both contain caramel coloring, an additive that has raised carcinogenicity concerns.[182] Only the soda's label, however, discloses that it contains the ingredient, along with calories and nutrition facts.

D. Promote healthier choice through federal food programs

In 2023, the federal government spent $166.4 billion on food and nutrition assistance programs.[183] The bulk of this funding went to the Supplemental Nutrition Assistance Program (SNAP), once known as food stamps, with child nutrition programs, including school meals, representing the next largest chunk. Federal policymakers can use this spending to greatly influence the food system, including by targeting UPFs.

1. Leverage SNAP to nudge food retailers

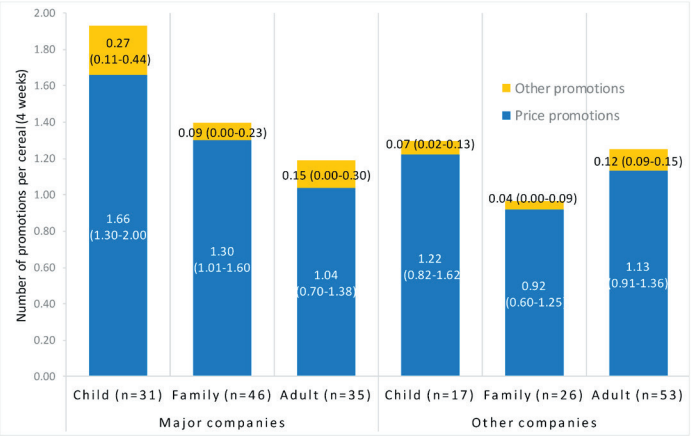
Research on the impact of federal nutrition assistance programs finds that improving diet quality, a core SNAP objective, would improve child health.[184] In 2023, some 42.1 million consumers in the U.S. received $112.8 billion in SNAP benefits.[185] This amounts to about ten percent of the $1.1 trillion of "food at home" sales, a potentially powerful incentive to influence the foods that retailers sell and



Source: USDA, Economic Research Service using USDA, FNS data and USDA, Agricultural Marketing Service data.

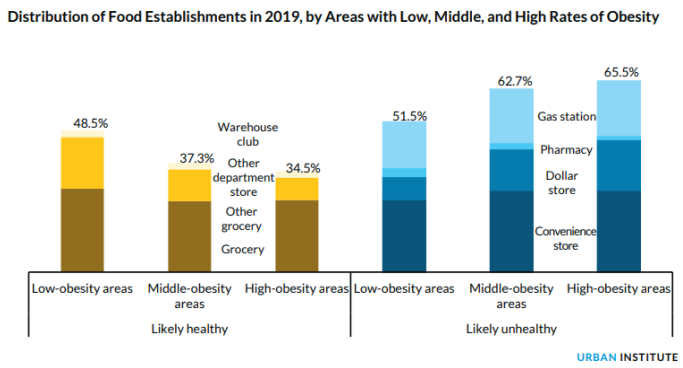
how they promote them.[186] Hunger relief advocates, along with industry, have stymied efforts to restrict the range of foods available for purchase under SNAP (e.g. soda bans).[187] Groups like the Food Research & Action Center (a CFA member) maintain that restricting foods available to SNAP recipients would create stigma and create administrative challenges.[188] Expanding SNAP healthy incentive programs that offer increased benefits for fruit and vegetable purchases have attracted more support, but these subsidies require additional funding from Congress.[189] Added eligibility conditions for retailers to participate in SNAP could create value without burdening taxpayers or curtailing SNAP recipients' choices.

Doing so could come in several forms. For larger food retailers, the site of 80% of SNAP purchases, SNAP eligibility requirements could include marketing standards designed to restrict the in-store marketing of unhealthy foods, such as soda endcaps, and promote healthier foods. Studies show that in-store product placement greatly affects what consumers buy.[190] Product promotions, "slotting allowances" paid by food manufacturers to retailers in exchange for shelf space, and other marketing activities often seek to sell unhealthy foods to children.[191] In one study of store promotions, researchers found that cereals marketed to children were much more likely to command endcaps and other promotional displays, as shown in the figure below.



Source: L. Harris, J., Webb, V., J. Sacco, S., & L. Pomeranz, J. (2020). Marketing to Children in Supermarkets: An Opportunity for Public Policy to Improve Children's Diets. International Journal of Environmental Research and Public Health, 17(4), 1284. https://doi.org/10.3390/ijerph17041284

SNAP eligibility requirements could place limits on these activities, and even direct retailers to dedicate a certain proportion of promotional space—e.g. end caps, checkout—to healthier foods. For online sales, USDA could require SNAP retailers to design recommendation algorithms and other features to nudge consumers towards healthier choices.[192]



Source: Waxman, E., Butrica, B., Pancini, V., Echave, P., Tabb, L., & Waidmann, T. A. (2023). Retail Food Access and Obesity Prevalence. Urban Institute. https://www.urban.org/research/publication/retail-food-access-and-obesity-prevalence

Stocking standards offer another nudge opportunity. Specifically, Congress and USDA could amend the stocking standards for SNAP retailers to require more healthy foods. Currently, SNAP retailers may offer just 36 "staple food items"—three units of three varieties across four categories, only two of which need be "perishable."[193] Dollar stores, convenience stores, and other small food retailers that meet the bare minimum required under these standards are more likely to sell unhealthy foods, and more likely to be located in areas with high rates of obesity.[194] Stronger, appropriately tailored,[195] stocking standards could give consumers relying on these retailers healthier options.

2. Raising school meal standards

School meals must be "consistent with the goals of the most recent Dietary Guidelines for Americans," an important reason for acknowledging UPFs in the DGAs.[196] However, even if the next DGAs ignore UPFs, federal policymakers can reform school meal standards to mitigate the harmful effects of UPFs. In recent years, implementation of the 2010 Healthy, Hunger-Free Kids Act has resulted in school children eating more whole grains, fruits and vegetables, and lean protein, and less sugar, fat and sodium.[197] However, the law has also led to some regrettable substitutions.

In particular, as school food vendors have sought to meet standards for less added sugar, many have reformulated products with artificial sweeteners. According to one recent analysis of 840 "competitive foods" offered in schools, 16% contained non-sugar sweeteners[198]. The current DGAs warn against giving children under two artificially sweetened foods out of concern that they "may develop preferences for overly sweet foods."[199] Other authorities, such as the American Academy of Pediatrics and the American Heart Association, have advised against children of all ages consuming artificial sweeteners.[200] In addition to distorting taste preferences, researchers have raised the concern that artificial sweeteners may disrupt the microbiome in a way that raises the risk of metabolic disease and obesity.[201]

Artificial sweeteners are not the only ingredient of concern in school foods. The same "competitive foods" survey cited above found that 21% of products contained synthetic dyes.[202] However, while USDA may arguably restrict foods with artificial sweeteners on the basis of the DGA's recommendations for children ages 0-2, nothing in the current DGAs mentions artificial dyes, underscoring the potential for the next DGAs to affect public policy through advice related to UPFs. Until then, state and local policymakers may choose to take action. For example, California legislators recently passed the California School Food Safety Act—not to be confused with the previously mentioned California Food Safety Act—which would ban six different food dyes in school meals.[203]

Of course, simply banning UPF ingredients from school foods will accomplish little if schools do not have the funding to provide healthier alternatives to students. The federal reimbursement rate for school lunches during the 2024-2025 school year is just $4.43.[204] For breakfast it's $2.37. This year's lunch reimbursement fell 37 cents due to the expiration of the Keep Kids Fed Act.[205] That law extended pandemic era school meal benefits, which included a nationwide experiment with universal free school meals. Since Congress cut off federal funding for free school meals, eight states have adopted free meal program themselves, with similar legislation proposed in many others.[206]

Congress should invest more in school meals, including by making them free to all students. Studies of free meal programs have found positive associations with diet quality, food security, and academic performance.[207] Universal free meal policies eliminate some of the uncertainty around how many meals to prepare, and help school districts justify

the labor, equipment and infrastructure expenses associated with healthier scratch cooking.[208] Better funding for school meals could also reduce the appeal of "copycat" programs like Domino's "Smart Slice," offering marginally healthier versions of junk food with a promise to "boost participation."[209]

In many schools, scratch cooking has created benefits beyond merely feeding students healthier meals. Skilled chefs may double as culinary education instructors, helping to counter a societal decline in cooking skills.[210] This decline contributes to an unhealthy food culture that some researchers have fingered as the key culprit behind our ever-expanding waistlines.[211] Fortunately, the experience of many schools in the U.S. and abroad indicates that teaching kids to cook and enjoy quality food can have lasting benefits.[212]

E. Regulate food marketing to children

In 1978, the Federal Trade Commission (FTC) proposed rules that would have banned broad categories of junk food advertising to children.[213] The industry quickly mustered forces and convinced Congress to strip the FTC of its authority to regulate "children's advertising."[214] Since that time, industry has largely regulated itself, an approach whose limitations have grown more intolerable as marketing efforts have shifted from television to online platforms, such as YouTube.[215]

The United States' hands-off approach increasingly contrasts with restrictions on food marketing to children in other countries. Indeed, the United Nations Children's Fund (UNICEF) has framed laws to reduce children's exposure to food marketing as fundamental human rights protections. In the U.S., by contrast, expansive "commercial speech" protections under the First Amendment may constrain policymakers from adopting some measures taken by our major trading partners, such as banning all cartoon mascots on cereal boxes.[216]

Source: Popkin, B. M., Barquera, S., Corvalan, C., Hofman, K. J., Monteiro, C., Ng, S. W., Swart, E. C., & Taillie, L. S. (2021). Toward unified and impactful policies for reducing ultraprocessed food consumption and promoting healthier eating globally. The Lancet. Diabetes & Endocrinology, 9(7), 462–470. https://doi.org/10.1016/S2213-8587(21)00078-4

However, were Congress to lift its injunction on the FTC, the agency could pursue a number of policies to protect children from data collection and advertising practices that exploit their inability to distinguish sponsored content.[217] Outlawing these "unfair and deceptive" methods would create a level playing field for companies that do not want to manipulate children for the sake of their bottom line.

F. Protect food industry stakeholders from monopoly power

Many consumers would like to reduce calories from UPFs in their diet, but struggle to do so for lack of access to alternative foods.[218] Over the last 25 years, the number of grocery stores has declined by a third.[219] According to industry estimates, just four companies—Walmart, Kroger, Costco, and Albertsons controlled 49.3% of the food retail market in 2023.[220] The proportion of UPFs to less processed foods on offer varies dramatically from one retailer to another.[221] In some stores, practically everything in a package qualifies as a UPF.[222]

Availability of non-UPF options in major U.S. retailers

	Walmart	Whole Foods	Kroger	Dollar General	Aldi
Mayonnaise	Yes	Yes	Yes	No	No
Ice Cream	Yes	Yes	Yes	No	No
Chocolate Chips	Yes	Yes	Yes	No	No
Pickles	Yes	Yes	Yes	No	No
Potato Chips	Yes	Yes	Yes	Yes	No
Tortillas (corn or flour)	No	Yes	No	No	Yes
Granola Bars	Yes	Yes	Yes	No	No
Carbonated Drink	Yes	Yes	Yes	No	No
Peanut Butter	Yes	Yes	Yes	No	Yes
Breakfast Cereal	Yes	Yes	Yes	Yes	Yes
Yogurt	Yes	Yes	Yes	No	Yes
Pasta Sauce	Yes	Yes	Yes	Yes	Yes
Soup	Yes	Yes	Yes	No	No
Sandwich bread	No	Yes	No	No	No
Crackers	Yes	Yes	Yes	No	No

Source: Consumer Federation of America. Data based on products sold online via U.S. store websites

Raising awareness about the health concerns associated with UPFs will only create frustration if consumers cannot act on that information. While public health authorities may decide to ban some of the worst offending ingredients, consumers will ultimately have to choose whether the cost, convenience, and beneficial nutritional characteristics of any given UPF outweigh the hazards posed by its ingredients. Ideally, a consumer could compare the price between, say, an ice cream brand containing emulsifiers and added flavors, and another one without those ingredients. If the consumer has only one or two options for where to shop, however, such a choice may not be available.

Fostering competition in the food system represents an important strategy for reducing UPF-related harms. The magic of the marketplace can do wonders, but only under the appropriate conditions. Those include adequate information, and adequate competition. Proposed mergers like the one between Kroger and Albertsons would exacerbate already problematic levels of consolidation within the food industry. Vigorous anti-trust enforcement, along with policies to support local and regional food systems, can ensure that consumers are able to modify what they eat in response to accurate information about food ingredients.

G. Levy a National Soda Tax

Among UPFs, sugar-sweetened beverages (SSBs) stand out for their insult to public health. Unlike some other "high in" foods, they provide virtually no essential nutrients, vitamins, minerals, or fiber, just "empty calories," in a liquid form that offers little satiety[223] and jacks up blood glucose[224] relative to similarly sugary solid foods. The excess sugar that SSBs deliver with unique efficacy drives adverse health conditions including obesity, type 2 diabetes, heart disease, kidney diseases, non-alcoholic liver disease, and gout.[225] The combination of sugars and acids in soda cause cavities, and according to some estimates, declines in dental care alone would reap hundreds of millions of dollars in savings from a soda tax.[226]

SSB taxes in the U.S. have raised revenues for early childhood education, libraries and community rec centers, and fresh produce subsidies, among other beneficial programs.[227] Their main value, however, lies in reducing consumption. A recent study of five U.S. jurisdictions with SSB taxes found a 33% average reduction in purchase volume.[228] These reductions will yield important public health benefits. Modeling based on healthcare data and food intake surveys suggests that just a 10% average reduction in SSB servings across the U.S. would prevent 238,000 cardiovascular events and 110,000 diabetes mellitus cases over 10 years.[229]

Unfortunately, the soda industry has fought tooth and nail to stop state and local tax initiatives. Following the city of Berkeley's passage of the nation's first SSB tax in 2014, industry lobbyists convinced state legislators in California and several other states to pass bills preempting any new local beverage or food taxes.[230] The industry has also stymied federal SSB tax legislation.[231] Soda manufacturers' leading argument has been that SSB taxes are regressive and disproportionately affect low-income and minority communities. But these are also the communities most devastated by the diet-related disease epidemic.

VI. Conclusion

For decades, the food industry and its allies have framed policies that might restrict harmful substances in food, or attempt to nudge consumers towards healthier options, as an affront to personal freedom. In 2005, FTC Commissioner Thomas Leary derided proposals to restrict "non-deceptive promotion of unhealthy food to kids" by saying "I really don't want to be part of a nanny agency or a nanny state."[232] In other words, you have the freedom to choose whether your children watch junk food ads on TV (or YouTube). You have the freedom to choose whether to buy those foods. You have the freedom to choose whether to eat foods with chemicals that might compromise your long-term health, etc., etc. But increasingly, consumers across the political spectrum are coming to appreciate that large food companies, left to their own devices, now pose the greater threat to freedom.

Compared to registered Democrats or Republicans, there are now more than twice as many adults in the U.S. who are overweight or obese. More and more consumers want relief from a food environment that they suspect, with good reason, is making them sick. Could this common suffering create a powerful new political constituency? Some Republican lawmakers seem to think so. Senators Ron Johnson and Mike Crapo recently presided over a public meeting to discuss, among other topics, "how whole natural foods have been replaced by ultra-processed foods."[233] The Trump aligned Make America Healthy Again campaign has called for "increasing access to nutritious food."[234] Notwithstanding charges of hypocrisy,[235] the departure from the "nanny state" rhetoric is striking.

In reality, there is no "impartial" arrangement that maximizes individual autonomy. Our food environment dictates the foods we eat to a greater extent than most of us appreciate, for better or worse.[236] Public policy will always have to set the rules for how the food system operates, and to reconcile the competing interests of many different stakeholders, including profit-seeking food companies and consumers with different preferences regarding convenience, price, taste, and healthfulness. The proliferation of UPFs on store shelves, and the accompanying climb in disease rates, demonstrates a need to strike a better balance between profit and public health. The policies outlined within this report offer several means for doing so.

Endnotes

1. Menichetti, G., Ravandi, B., Mozaffarian, D. et al. Machine learning prediction of the degree of food processing. Nat Commun 14, 2312 (2023). https://doi.org/10.1038/s41467-023-37457-1

2. Highly processed foods form bulk of U.S. youths' diets. (2021, August 23). National Institutes of Health. https://www.nih.gov/news-events/nih-research-matters/highly-processed-foods-form-bulk-us-youths-diets

3. Amaraggi, B., Wood, W., Martín, L. G., Sánchez, J. G., Sánchez, Y. F., & Puentes, A. de la G. (2024). Ultra-processed food staples dominate mainstream U.S. supermarkets. Americans more than Europeans forced to choose between health and cost (p. 2024.02.16.24302894). MedRxiv. https://doi.org/10.1101/2024.02.16.24302894

4. *Id.*

5. Rico-Campà, A., et al (2019). Association between consumption of ultra-processed foods and all cause mortality: SUN prospective cohort study. BMJ *(Clinical Research Ed.)*, 365, l1949. https://doi.org/10.1136/bmj.l1949

6. Juul, F., Vaidean, G., Lin, Y., Deierlein, A. L., & Parekh, N. (2021). Ultra-Processed Foods and Incident Cardiovascular Disease in the Framingham Offspring Study. *Journal of the American College of Cardiology*, 77(12), 1520–1531. https://doi.org/10.1016/j.jacc.2021.01.047

7. Pure Food and Drug Act of 1906, 21 U.S.C. §§ 1-15.

8. Why Good Nutrition is Important. Center for Science in the Public Interest. Retrieved September 19, 2024, from https://www.cspinet.org/eating-healthy/why-good-nutrition-important

9. Achenbach, J., Keating, D., McGinley, L., Johnson, A., & Chikwendiu, J. (2024, October 3). An epidemic of chronic illness is killing us too soon. Washington Post. https://www.washingtonpost.com/health/interactive/2023/american-life-expectancy-dropping/

10. Cha, A. E. (2024, October 3). Fatty liver was a disease of the old. Then kids started getting sick. Washington Post. https://www.washingtonpost.com/health/interactive/2023/nonalcoholic-fatty-liver-disease-kids/

11. Lehner, P. (2016, August 15). The Hidden Costs of Food. Earthjustice. https://earthjustice.org/article/the-hidden-costs-of-food

12. The *AP Stylebook* now advises against using "obese" as a modifier "when possible." However, there is considerable debate over how to describe people afflicted by the obesity epidemic. While this report uses "people first" language where convention and ease of understanding permits, more longstanding terminology is also employed. *See* Haspel, T. (2024, June 3). The Obese Police. *The Atlantic*. https://www.theatlantic.com/health/archive/2024/06/person-with-obesity-language-phrasing/678584/

13. Cawley, J., Biener, A., Meyerhoefer, C., Ding, Y., Zvenyach, T., Smolarz, B. G., & Ramasamy, A. (2021). Direct medical costs of obesity in the United States and the most populous states. *Journal of Managed Care & Specialty Pharmacy*, 27(3), 354–366. https://doi.org/10.18553/jmcp.2021.20410

14. Obesity's Impact on New York's Economy and Workforce in 2022. (September, 2023). GlobalData. https://www.globaldata.com/health-economics/US/NewYork/Obesity-Impact-on-NewYork-Fact-Sheet.pdf

15. O'Neill Hayes, T., & Asres, R. (2022). The Economic Costs of Poor Nutrition. American Action Forum. https://www.americanactionforum.org/research/the-economic-costs-of-poor-nutrition/

16. O'Hearn, M., Liu, J., Cudhea, F., Micha, R., & Mozaffarian, D. (2021). Coronavirus Disease 2019 Hospitalizations Attributable to Cardiometabolic Conditions in the United States: A Comparative Risk Assessment Analysis. *Journal of the American Heart Association*, 10(5), e019259. https://doi.org/10.1161/JAHA.120.019259

17. *Id.*

18. COVID-19 and Obesity: The 2021 Atlas. (March 2021). World Obesity Federation. https://www.worldobesityday.org/assets/downloads/COVID-19-and-Obesity-The-2021-Atlas.pdf

19. Obesity and Overweight. (2023, December 27). National Center for Health Statistics. https://www.cdc.gov/nchs/fastats/obesity-overweight.htm

20. Caprio, S., Daniels, S. R., Drewnowski, A., Kaufman, F. R., Palinkas, L. A., Rosenbloom, A. L., & Schwimmer, J. B. (2008). Influence of Race, Ethnicity, and Culture on Childhood Obesity: Implications for Prevention and Treatment. *Diabetes Care*, 31(11), 2211–2221. https://doi.org/10.2337/dc08-9024

21. Some researchers argue that overweight and obesity, defined solely in terms of body-mass index or BMI, should not alone

be classified as a disease. *See* Denis, G. V., & Hamilton, J. A. (2013). Healthy obese persons: How can they be identified and do metabolic profiles stratify risk? *Current Opinion in Endocrinology, Diabetes, and Obesity*, 20(5), 369–376. https://doi.org/10.1097/01.med.0000433058.78485.b3. However, large epidemiological studies have found that even metabolically healthy individuals with obesity are at an increased risk for stroke, heart failure and other adverse events compared to "individuals who are normal weight with no metabolic risk factors." See Caleyachetty, R., Thomas, G. N., Toulis, K. A., Mohammed, N., Gokhale, K. M., Balachandran, K., & Nirantharakumar, K. (2017). Metabolically Healthy Obese and Incident Cardiovascular Disease Events Among 3.5 Million Men and Women. *Journal of the American College of Cardiology*, 70(12), 1429–1437. https://doi.org/10.1016/j.jacc.2017.07.763

22. Fothergill, E., Guo, J., Howard, L., Kerns, J. C., Knuth, N. D., Brychta, R., Chen, K. Y., Skarulis, M. C., Walter, M., Walter, P. J., & Hall, K. D. (2016). Persistent metabolic adaptation 6 years after The Biggest Loser competition. *Obesity, 24*(8), 1612–1619. https://doi.org/10.1002/oby.21538

23. *Id.*

24. *Id.*

25. Gulliford, M. C., et al (2016). What is the probability of an obese person attaining normal body weight? In Costs and outcomes of increasing access to bariatric surgery for obesity: Cohort study and cost-effectiveness analysis using electronic health records. *NIHR Journals Library*. https://www.ncbi.nlm.nih.gov/books/NBK362452/

26. Wilding, J. P. H., et al (2021). Once-Weekly Semaglutide in Adults with Overweight or Obesity. *New England Journal of Medicine*, 384(11), 989–1002. https://doi.org/10.1056/NEJMoa2032183

27. Bouchard, C. (2021). Genetics of Obesity: What We Have Learned Over Decades of Research. *Obesity, 29(5)*, 802–820. https://doi.org/10.1002/oby.23116

28. *Id.*

29. Qi, L. (2012, November 19). Ask the expert: Sugary drinks and genetic risk for obesity. The Nutrition Source. https://nutritionsource.hsph.harvard.edu/2012/11/19/ask-the-expert-sugary-drinks-and-genetic-risk-for-obesity/

30. von Hippel, P. T., & Nahhas, R. W. (2013). Extending the history of child obesity in the United States: The fels longitudinal study, birth years 1930-1993. Obesity, 21(10), 2153–2156. https://doi.org/10.1002/oby.20395; see also Bray, G. A. (2024). Obesity: A 100 year perspective. *International Journal of Obesity (2005)*. https://doi.org/10.1038/s41366-024-01530-6

31. Childhood Obesity Facts. (2024, June 4). Centers for Disease Control. https://www.cdc.gov/obesity/php/data-research/childhood-obesity-facts.html ("From 2017 to March 2020, the prevalence of obesity among U.S. children and adolescents was 19.7%. This means that approximately 14.7 million U.S. youths aged 2–19 years have obesity.").

32. Cunningham, S. A., Hardy, S. T., Jones, R., Ng, C., Kramer, M. R., & Narayan, K. M. V. (2022). Changes in the Incidence of Childhood Obesity. *Pediatrics, 150(2)*, e2021053708. https://doi.org/10.1542/peds.2021-053708 ("Children from the most socioeconomically disadvantaged households experienced 15% higher cumulative incidence across primary school in 2010 than 1998.").

33. Perng, W., Conway, R., Mayer-Davis, E., & Dabelea, D. (2023). Youth-Onset Type 2 Diabetes: The Epidemiology of an Awakening Epidemic. *Diabetes Care, 46(3)*, 490–499. https://doi.org/10.2337/dci22-0046

34. Sforza, L. (2023, August 17). Opioids, obesity now ranked as top public health threats in new poll. The Hill. https://thehill.com/policy/healthcare/4156590-opioids-obesity-now-ranked-as-top-public-health-threats-in-new-poll/

35. Kikuchi, E., & Tyson, A. (2024). How Americans View Weight-Loss Drugs and Their Potential Impact on Obesity in the U.S. Pew Research Center. https://www.pewresearch.org/science/2024/02/26/how-americans-view-weight-loss-drugs-and-their-potential-impact-on-obesity-in-the-u-s/

36. Decline in Early Childhood Obesity in WIC Families. (2016, January 1). Centers for Disease Control. https://archive.cdc.gov/www_cdc_gov/media/releases/2019/p1121-decline-childhood-obesity-wic-families.html

37. Chandran A, Burjak M, Petimar J, et al. Changes in Body Mass Index Among School-Aged Youths Following Implementation of the Healthy, Hunger-Free Kids Act of 2010. *JAMA Pediatr.* 2023;177(4):401–409. doi:10.1001/jamapediatrics.2022.5828

38. Speakman, J. R., et al (2023). Total daily energy expenditure has declined over the last 3 decades due to declining basal expenditure not reduced activity expenditure. *Nature Metabolism, 5(4)*, 579–588. https://doi.org/10.1038/s42255-023-00782-2

39. Magkos, F., et al (2024). On the pathogenesis of obesity: Causal models and missing pieces of the puzzle. *Nature Metabolism*, 1–10. https://doi.org/10.1038/s42255-024-01106-8

40. Monteiro, C. A., Levy, R. B., Claro, R. M., Castro, I. R. R. de, & Cannon, G. (2010). A new classification of foods based on the extent and purpose of their processing. *Cadernos de Saúde Pública, 26*, 2039–2049. https://doi.org/10.1590/S0102-311X2010001100005

41. *Id.*

42. Monteiro, C. A., et al (2019). Ultra-processed foods: What they are and how to identify them. Public Health Nutrition, 22(5), 936–941. https://doi.org/10.1017/S1368980018003762

43. *Id.*

44. *Id.*

45. Popkin, B. M., Miles, D. R., Taillie, L. S., & Dunford, E. K. (2024). A policy approach to identifying food and beverage products that are ultra-processed and high in added salt, sugar and saturated fat in the United States: A cross-sectional analysis of packaged foods. *The Lancet Regional Health - Americas*, 32, 100713. https://doi.org/10.1016/j.lana.2024.100713

46. *See* Ravandi, B., Mehler, P., Ispirova, G., Barabási, A.-Ĺ., & Menichetti, G. (2024). *Prevalence of Processed Food in Grocery Stores* (p. 2022.04.23.22274217). medRxiv. https://doi.org/10.1101/2022.04.23.22274217 ("While grocery stores offer a large variety of products, the offered processing choices can be identical in multiple stores. For example, GroceryDB has a comparable number of cookies & biscuits in each chain, with 373, 451, and 402 items in Walmart, Target, and WholeFoods, respectively. The degree of processing of cookies & biscuits in Walmart and Target are nearly identical (0.88 < FPro < 1), limiting consumer nutritional choices in a narrow range of processing (Figure 4a). In contrast, WholeFoods not only offers a large number of items (402 cookies & biscuits), but it also offers a wider choices of processing (0.57 < FPro < 1)."

47. Gremillion, T. (2024, February 16). Not Sure Whether to Sell Girl Scout Cookies? You're Not the Only One. Consumer Federation of America. https://consumerfed.org/not-sure-whether-to-sell-girl-scout-cookies-youre-not-the-only-one/

48. Anastasiou, K., Melo, P. R. D., Slater, S., Hendrie, G. A., Hadjikakou, M., Baker, P. K., & Lawrence, M. A. (2023). From harmful nutrients to ultra-processed foods: Exploring shifts in 'foods to limit' terminology used in national food-based dietary guidelines. *Public Health Nutrition, 26(11)*, 2539–2550. https://doi.org/10.1017/S1368980022002580

49. *Id.*

50. Valicente, et al (2023). Ultraprocessed Foods and Obesity Risk: A Critical Review of Reported Mechanisms. *Advances in Nutrition, 14(4)*, 718–738. https://doi.org/10.1016/j.advnut.2023.04.006

51. Zancheta Ricardo, C., Duran, A. C., Grilo, M. F., Rebolledo, N., Díaz-Torrente, X., Reyes, M., & Corvalán, C. (2023). Impact of the use of food ingredients and additives on the estimation of ultra-processed foods and beverages. *Frontiers in Nutrition*, 9. https://doi.org/10.3389/fnut.2022.1046463

52. Resources. Food Processing Facts. Retrieved September 24, 2024, from https://foodprocessingfacts.org/resources/

53. Monteiro, C. A., et al (2019). Ultra-processed foods: What they are and how to identify them. *Public Health Nutrition, 22(5)*, 936–941. https://doi.org/10.1017/S1368980018003762

54. *Compare* Zancheta Ricardo, C., Duran, A. C., Grilo, M. F., Rebolledo, N., Díaz-Torrente, X., Reyes, M., & Corvalán, C. (2023). Impact of the use of food ingredients and additives on the estimation of ultra-processed foods and beverages. *Frontiers in Nutrition*, 9. https://doi.org/10.3389/fnut.2022.1046463 *with* Meadows, A.D.; Swanson, S.A.; Galligan, T.M.; Naidenko, O.V.; O'Connell, N.; Perrone-Gray, S.; Leiba, N.S. Packaged Foods Labeled as Organic Have a More Healthful Profile Than Their Conventional Counterparts, According to Analysis of Products Sold in the U.S. in 2019–2020. *Nutrients* 2021 https://doi.org/10.3390/nu13093020 *and* Popkin *supra* note 44.

55. Zancheta *supra* note 54.

56. *See* https://us.openfoodfacts.org/

57. Some researchers have proposed defining UPFs through machine learning algorithms. *See, e.g.* Menichetti, *supra* note 1.

58. Lane, M. M., et al. (2024). Ultra-processed food exposure and adverse health outcomes: Umbrella review of epidemiological meta-analyses. *BMJ, 384*, e077310. https://doi.org/10.1136/bmj-2023-077310

59. Henney, A. E., Gillespie, C. S., Alam, U., Hydes, T. J., Mackay, C. E., & Cuthbertson, D. J. (2024). High intake of ultra-processed food is associated with dementia in adults: A systematic review and meta-analysis of observational studies. *Journal of Neurology*, 271(1), 198–210. https://doi.org/10.1007/s00415-023-12033-1

60. Chang, K., Gunter, M. J., Rauber, F., Levy, R. B., Huybrechts, I., Kliemann, N., Millett, C., & Vamos, E. P. (2023). Ultra-processed food consumption, cancer risk and cancer mortality: A large-scale prospective analysis within the UK Biobank. *eClinicalMedicine*, 56. https://doi.org/10.1016/j.eclinm.2023.101840

61. Dicken, S.J.; Batterham, R.L. The Role of Diet Quality in Mediating the Association between Ultra-Processed Food Intake, Obesity and Health-Related Outcomes: A Review of Prospective Cohort Studies. Nutrients 2022, 14, 23. https://doi.org/10.3390/nu14010023

62. *See, e.g.* https://www.npr.org/sections/health-shots/2023/05/25/1178163270/ultra-processed-foods-health-risk-weight-gain (quoting Hall as saying ""I had sort of expected that ... there wouldn't be any difference," between participants eating a UPF and less processed diet).

63. Hall, K. D. (2019). *Ultra-processed diets cause excess calorie intake and weight gain: A one-month inpatient randomized controlled trial of ad libitum food intake.* https://doi.org/10.31232/osf.io/w3zh2

64. For an overview, *see*: Dicken, S. J., & Batterham, R. L. (2024). Ultra-processed Food and Obesity: What Is the Evidence? *Current Nutrition Reports, 13*(1), 23–38. https://doi.org/10.1007/s13668-024-00517-z

65. *The Dorito Effect*. Mark Schatzker. https://www.markschatzker.com/doritoeffect-home-page

66. Slyper A. Oral Processing, Satiation and Obesity: Overview and Hypotheses. *Diabetes Metab Syndr Obes*. 2021 Jul 26;14:3399-3415. doi: 10.2147/DMSO.S314379. PMID: 34345176.

67. *See, e.g.* Fardet A. Minimally processed foods are more satiating and less hyperglycemic than ultra-processed foods: a preliminary study with 98 ready-to-eat foods. Food Funct. 2016;7(5):2338–2346. doi: 10.1039/C6FO00107F; Slyper A. Oral processing, satiation and obesity: overview and hypotheses. Diabetes Metab. Syndr. Obes. Targets Ther. 2021;14:3399–3415. doi: 10.2147/DMSO.S314379.

68. Teo, P. S., Lim, A. J., Goh, A. T., Janani, R., Michelle Choy, J. Y., McCrickerd, K., & Forde, C. G. (2022). Texture-based differences in eating rate influence energy intake for minimally processed and ultra-processed meals. *The American Journal of Clinical Nutrition, 116*(1), 244–254. https://doi.org/10.1093/ajcn/nqac068

69. Forde, C. G., & Bolhuis, D. (2022). Interrelations Between Food Form, Texture, and Matrix Influence Energy Intake and Metabolic Responses. *Current Nutrition Reports, 11*(2), 124–132. https://doi.org/10.1007/s13668-022-00413-4

70. Feeney, E. L., et al (2018). Dairy matrix effects: Response to consumption of dairy fat differs when eaten within the cheese matrix—a randomized controlled trial. *The American Journal of Clinical Nutrition, 108*(4), 667–674. https://doi.org/10.1093/ajcn/nqy146; *see also* Feeney, E. L., Lamichhane, P., & Sheehan, J. J. (2021). The cheese matrix: Understanding the impact of cheese structure on aspects of cardiovascular health – A food science and a human nutrition perspective. *International Journal of Dairy Technology, 74*(4), 656–670. https://doi.org/10.1111/1471-0307.12755

71. Aguilera, J. M. (2019). The food matrix: Implications in processing, nutrition and health. *Critical Reviews in Food Science and Nutrition, 59*(22), 3612–3629. https://doi.org/10.1080/10408398.2018.1502743

72. *See, e.g.* Popkin *supra* note 44.

73. Fazzino, T. L., Rohde, K., & Sullivan, D. K. (2019). Hyper-Palatable Foods: Development of a Quantitative Definition and Application to the US Food System Database. *Obesity, 27*(11), 1761–1768. https://doi.org/10.1002/oby.22639

74. Humphrey, J. (2023, September 5). *Q & A with researcher Tera Fazzino: What to know about "hyperpalatable" foods*. Life Span Institute. https://lifespan.ku.edu/news/article/2023/09/05/q-researcher-tera-fazzino-what-know-about-hyperpalatable-foods

75. Chris Van Tulleken. *Ultra-Processed People*. Norton (2023).

76. Veldhuizen, M. G., et al (2017). Integration of Sweet Taste and Metabolism Determines Carbohydrate Reward. *Current Biology, 27*(16), 2476-2485.e6. https://doi.org/10.1016/j.cub.2017.07.018

77. *See, e.g.*, Calcaterra, V., Cena, H., Rossi, V., Santero, S., Bianchi, A., Zuccotti, G. (2023). Ultra-Processed Food, Reward System and Childhood Obesity. *Children. 10(5):804.* https://www.mdpi.com/2227-9067/10/5/804

78. Salisu, S. (2023, September 11). *The Science of Craveability: Decoding the Senses*. Kerry. https://www.kerry.com/insights/kerry-digest/2023/science-of-craveability.html

79. Calcaterra, V., Cena, H., Rossi, V., Santero, S., Bianchi, A., Zuccotti, G. (2023). Ultra-Processed Food, Reward System and Childhood Obesity. *Children. 10(5):804.* https://www.mdpi.com/2227-9067/10/5/804

80. *See, e.g.*, Judson Brewer. *The Hunger Habit*.

81. Parnarouskis, L., & Gearhardt, A. N. (2022). Preliminary Evidence that Tolerance and Withdrawal Occur in Response to Ultra-processed Foods. *Current Addiction Reports, 9*(4), 282–289. https://doi.org/10.1007/s40429-022-00425-8

82. Ayton A., Ibrahim A., Dugan J., Galvin E., Wright O.W. (2021). Ultra-processed foods and binge eating: A retrospective observational study. *Nutrition. 84:111023.* doi: 10.1016/j.nut.2020.111023.

83. LaFata, E. M., & Gearhardt, A. N. (2022). Ultra-Processed Food Addiction: An Epidemic? *Psychotherapy and Psychosomatics, 91*(6), 363–372. https://doi.org/10.1159/000527322

84. Milhassi Vedovato, G., Vilela, S., Severo, M., Rodrigues, S., Lopes, C., and Oliveira, A. (2021). Ultra-processed food consumption, appetitive traits and BMI in children: a prospective study. *British Journal of Nutrition, 125*(12), 1427-1436. doi:10.1017/S0007114520003712

85. Via, E., Contreras-Rodríguez, O. (2023). Binge-Eating Precursors in Children and Adolescents: Neurodevelopment, and the Potential Contribution of Ultra-Processed Foods. *Nutrients. 15*(13):2994. doi: 10.3390/nu15132994.

86. LaFata, E. M., Allison, K. C., Audrain-McGovern, J., & Forman, E. M. (2024). Ultra-Processed Food Addiction: A Research Update. *Current Obesity Reports, 13*(2), 214–223. https://doi.org/10.1007/s13679-024-00569-w

87. Yeomans, M.R. (2012). Flavour–nutrient learning in humans: an elusive phenomenon? *Physiol Behav. 106:345–55.* https://doi.org/10.1016/j.physbeh.2012.03.013.

88. Neumann *supra* note 9.

89. *Id.*

90. Veldhuizen, M. G., et al (2017). Integration of Sweet Taste and Metabolism Determines Carbohydrate Reward. *Current Biology, 27*(16), 2476-2485.e6. https://doi.org/10.1016/j.cub.2017.07.018

91. *See* Mark Schatzker. *The End of Craving.*

92. Sender, R., Fuchs, S., & Milo, R. (2016). Revised Estimates for the Number of Human and Bacteria Cells in the Body. *PLoS Biology, 14*(8), e1002533. https://doi.org/10.1371/journal.pbio.1002533

93. Ogunrinola, G. A., Oyewale, J. O., Oshamika, O. O., & Olasehinde, G. I. (2020). The Human Microbiome and Its Impacts on Health. *International Journal of Microbiology, 2020*(1), 8045646. https://doi.org/10.1155/2020/8045646

94. Carmody, R. N., & Bisanz, J. E. (2023). Roles of the gut microbiome in weight management. *Nature Reviews Microbiology, 21*(8), 535–550. https://doi.org/10.1038/s41579-023-00888-0

95. Naimi, S., Viennois, E., Gewirtz, A.T. et al. Direct impact of commonly used dietary emulsifiers on human gut microbiota. *Microbiome 9*, 66 (2021). https://doi.org/10.1186/s40168-020-00996-6

96. Santamaria-Echart, A., Fernandes, I. P., Silva, S. C., Rezende, S. C., Colucci, G., Dias, M. M., & Barreiro, M. F. (2021). New Trends in Natural Emulsifiers and Emulsion Technology for the Food Industry. In *Natural Food Additives.* IntechOpen. https://doi.org/10.5772/intechopen.99892

97. De Siena, M., Raoul, P., Costantini, L., Scarpellini, E., Cintoni, M., Gasbarrini, A., Rinninella, E., & Mele, M. C. (2022). Food Emulsifiers and Metabolic Syndrome: The Role of the Gut Microbiota. *Foods, 11*(15), 2205. https://doi.org/10.3390/foods11152205

98. Partridge, D., Lloyd, K. A., Rhodes, J. M., Walker, A. W., Johnstone, A. M., & Campbell, B. J. (2019). Food additives: Assessing the impact of exposure to permitted emulsifiers on bowel and metabolic health – introducing the FADiets study. *Nutrition Bulletin, 44*(4), 329–349. https://doi.org/10.1111/nbu.12408

99. Chassaing, B., et al (2022). Randomized Controlled-Feeding Study of Dietary Emulsifier Carboxymethylcellulose Reveals Detrimental Impacts on the Gut Microbiota and Metabolome. Gastroenterology, 162(3), 743–756. https://doi.org/10.1053/j.gastro.2021.11.006

100. Roberts, C. L., Keita, Å. V., Duncan, S. H., O'Kennedy, N., Söderholm, J. D., Rhodes, J. M., & Campbell, B. J. (2010). Translocation of Crohn's disease Escherichia coli across M-cells: Contrasting effects of soluble plant fibres and emulsifiers. Gut, 59(10), 1331–1339. https://doi.org/10.1136/gut.2009.195370

101. Miclotte, L., et al (2020). Dietary Emulsifiers Alter Composition and Activity of the Human Gut Microbiota in vitro, Irrespective of Chemical or Natural Emulsifier Origin. *Frontiers in Microbiology, 11.* https://doi.org/10.3389/fmicb.2020.577474

102. IBD Facts and Stats. (2024, July 22). Centers for Disease Control. https://www.cdc.gov/inflammatory-bowel-disease/php/facts-stats/index.html

103. *The Connection Between Ultra-Processed Foods and Endocrine Disruptors.* STOP Obesity Alliance | Milken Institute School of Public Health. https://stop.publichealth.gwu.edu/LFD-dec21

104. Papalou, O., Kandaraki, E. A., Papadakis, G., & Diamanti-Kandarakis, E. (2019). Endocrine Disrupting Chemicals: An Occult Mediator of Metabolic Disease. Frontiers in Endocrinology, 10. https://doi.org/10.3389/fendo.2019.00112

105. Trasande, L., Shaffer, R. M., Sathyanarayana, S., COUNCIL ON ENVIRONMENTAL HEALTH, Lowry, J. A., Ahdoot, S., Baum, C. R., FACMT, Bernstein, A. S., Bole, A., Campbell, C. C., Landrigan, P. J., Pacheco, S. E., Spanier, A. J., & Woolf, A. D. (2018). Food Additives and Child Health. Pediatrics, 142(2), e20181410. https://doi.org/10.1542/peds.2018-1410

106. Amato, A. A., Wheeler, H. B., & Blumberg, B. (2021). Obesity and endocrine-disrupting chemicals. Endocrine Connections, 10(2), R87–R105. https://doi.org/10.1530/EC-20-0578

107. Braun, J. M. (2017). Early Life Exposure to Endocrine Disrupting Chemicals and Childhood Obesity and Neurodevelopment. Nature Reviews. Endocrinology, 13(3), 161–173. https://doi.org/10.1038/nrendo.2016.186

108. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10195631/

109. Brown, R. E., Sharma, A. M., Ardern, C. I., Mirdamadi, P., Mirdamadi, P., & Kuk, J. L. (2016). Secular differences in the association between caloric intake, macronutrient intake, and physical activity with obesity. Obesity Research & Clinical Practice, 10(3), 243–255. https://doi.org/10.1016/j.orcp.2015.08.007

110. Steele, E. M., Khandpur, N., Louzada, M. L. da C., & Monteiro, C. A. (2020). Association between dietary contribution of ultra-processed foods and urinary concentrations of phthalates and bisphenol in a nationally representative sample of the US population aged 6 years and older. *PLOS ONE, 15*(7), e0236738. https://doi.org/10.1371/journal.pone.0236738

111. Friedman, L. F. (2024, May 13). How to reduce your exposure to plastics in food (and everywhere else). *Washington Post.* https://www.washingtonpost.com/wellness/2024/05/13/plastics-food-water-safety-contamination/

112. Valicente, V. M., et al (2023). Ultraprocessed Foods and Obesity Risk: A Critical Review of Reported Mechanisms. *Advances in Nutrition, 14*(4), 718–738. https://doi.org/10.1016/j.advnut.2023.04.006

113. *Endocrine Disruptors and Your Health.* (March 2023). National Institutes of Health. https://www.niehs.nih.gov/sites/default/files/health/materials/endocrine_disruptors_508.pdf

114. Sathyanarayana, S., Alcedo, G., Saelens, B. E., Zhou, C., Dills, R. L., Yu, J., & Lanphear, B. (2013). Unexpected results in a randomized dietary trial to reduce phthalate and bisphenol A exposures. *Journal of Exposure Science & Environmental Epidemiology, 23*(4), 378–384. https://doi.org/10.1038/jes.2013.9

115. Zhang, X.-J., Diao, M., & Zhang, Y.-F. (2023). A review of the occurrence, metabolites and health risks of butylated hydroxyanisole (BHA). *Journal of the Science of Food and Agriculture, 103*(13), 6150–6166. https://doi.org/10.1002/jsfa.12676

116. *New York A6424A/S6055B food additives ban fact sheet.* (2024, March 4). Center for Science in the Public Interest. https://www.cspinet.org/resource/new-york-a6424as6055b-food-additives-ban-fact-sheet

117. *Pennsylvania HB 2117.* "An Act amending Title 3 (Agriculture) of the Pennsylvania Consolidated Statutes, in food protection, further providing for poisonous or deleterious substances and tolerances." Referred to House Rural and Agricultural Affairs Committee, March 19, 2024 *available at*: https://www.legis.state.pa.us/cfdocs/billInfo/billInfo.cfm?sYear=2023&sInd=0&body=H&type=B&bn=2117

118. Reales-Moreno, M., et al (2022). Ultra-Processed Foods and Drinks Consumption Is Associated with Psychosocial Functioning in Adolescents. *Nutrients, 14*(22), Article 22. https://doi.org/10.3390/nu14224831

119. Arnold, L. E., Lofthouse, N., & Hurt, E. (2012). Artificial Food Colors and Attention-Deficit/Hyperactivity Symptoms: Conclusions to Dye for. Neurotherapeutics, 9(3), 599–609. https://doi.org/10.1007/s13311-012-0133-x

120. Batada, A., & Jacobson, M. F. (2016). Prevalence of Artificial Food Colors in Grocery Store Products Marketed to Children. *Clinical Pediatrics, 55*(12), 1113–1119. https://doi.org/10.1177/0009922816651621

121. *Health Effects Assessment: Potential Neurobehavioral Effects of Synthetic Food Dyes in Children.* (2021). California Office of Environmental Health Hazard Assessment. https://oehha.ca.gov/risk-assessment/report/health-effects-assessment-potential-neurobehavioral-effects-synthetic-food

122. Curran, L. (2010, July 21). EU Places Warning Labels on Foods Containing Dyes. *Food Safety News.* https://www.foodsafetynews.com/2010/07/eu-places-warning-labels-on-foods-containing-dyes/

123. Potera, C. (2010). The Artificial Food Dye Blues. Environmental Health Perspectives, 118(10), A428.

124. Brein, C., & Golodner, L. (2010, March 29). Groups calling on FDA to match UK's ban on synthetic food dyes. *National Consumers League*. https://nclnet.org/groups_calling_on_fda_to_match_uk_s_ban_on_synthetic_food_dyes/

125. *Id.*

126. *Color Additives Questions and Answers for Consumers*. (2023, December 14). US Food & Drug Administration; FDA. https://www.fda.gov/food/color-additives-information-consumers/color-additives-questions-and-answers-consumers

127. *Id.*

128. Medintz, S. (2024, April 10). The Dangerous Dyes and Other Food Additives States Want to Ban. Consumer Reports. https://www.consumerreports.org/health/food-additives/dangerous-dyes-and-food-additives-states-want-to-ban-a3953720328/ and A.B. 2316, 2024 Pupil nutrition: substances: prohibition. (Ca. 2024). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202320240AB2316

129. Pomeranz, J. L., Mande, J. R., & Mozaffarian, D. (2023). U.S. Policies Addressing Ultraprocessed Foods, 1980-2022. *American Journal of Preventive Medicine, 65*(6), 1134–1141. https://doi.org/10.1016/j.amepre.2023.07.006

130. Thomas G. Neltner et al., "Navigating the U.S. Food Additive regulatory Program," Comprehensive Reviews in Food Science and Food Safety 10 (2011), p. 342.

131. A.B. 418, 2023. The California Food Safety Act (Ca. 2023). https://legiscan.com/CA/text/AB418/id/2839554

132. *Banned Additives & Ingredients in Europe & How Food Companies Are Affected*. (2022, June 20). RegASK. https://regask.com/food-additives-ingredients-banned-eu/

133. *FDA Revokes Regulation Allowing the Use of Brominated Vegetable Oil (BVO) in Food*. (2024, July 2). U.S. Food and Drug Administration; FDA. https://www.fda.gov/food/cfsan-constituent-updates/fda-revokes-regulation-allowing-use-brominated-vegetable-oil-bvo-food

134. 21 U.S.C. § 321(s).

135. 21 U.S.C. § 321(s).

136. Neltner, T. G., Kulkarni, N. R., Alger, H. M., Maffini, M. V., Bongard, E. D., Fortin, N. D., & Olson, E. D. (2011). Navigating the U.S. Food Additive Regulatory Program. *Comprehensive Reviews in Food Science and Food Safety, 10*(6), 342–368. https://doi.org/10.1111/j.1541-4337.2011.00166.x

137. Neltner, T. G., Alger, H. M., O'Reilly, J. T., Krimsky, S., Bero, L. A., & Maffini, M. V. (2013). Conflicts of interest in approvals of additives to food determined to be generally recognized as safe: Out of balance. *JAMA Internal Medicine, 173*(22), 2032–2036. https://doi.org/10.1001/jamainternmed.2013.10559

138. *FDA Should Strengthen Its Oversight of Food Ingredients Determined to Be Generally Recognized as Safe (GRAS)*. (2010, March 5). U.S. Government Accountability Office. https://www.gao.gov/products/gao-10-246

139. Food Chemical Reassessment Act of 2023, H.R.3927, 118th Congress. https://www.congress.gov/bill/118th-congress/house-bill/3927/text

140. *Brominated Vegetable Oil (BVO)*. (2024, July 2). US Food & Drug Administration; FDA. https://www.fda.gov/food/food-additives-petitions/brominated-vegetable-oil-bvo

141. *List of Select Chemicals in the Food Supply Under FDA Review*. (2024, September 24). US Food & Drug Administration; FDA. https://www.fda.gov/food/food-chemical-safety/list-select-chemicals-food-supply-under-fda-review

142. *FDA Deputy Commissioner Highlights Agency Focus on Food Chemical Safety*. (2024, June 11). PackingLaw. https://www.packaginglaw.com/news/fda-deputy-commissioner-highlights-agency-focus-food-chemical-safety

143. *Approved Human Foods Program Organization Chart*. (2024, May 30). US Food & Drug Administration. https://www.fda.gov/media/172384/download

144. National Institutes of Health (NIH) Funding: FY1996-FY2023 (March, 2023). Congressional Research Service. https://crsreports.congress.gov/product/pdf/R/R43341/45

145. Florko, N. (2024, September 11). *How a government scientist is pushing to supersize research into ultra-processed foods*. STAT. https://www.statnews.com/2024/09/11/ultra-processed-foods-health-nih-research-kevin-hall-controlled-trials/

146. Boudreau, C., & Bottemiller Evich, H. (2019, November 4). How Washington keeps America sick and fat. POLITICO. https://www.politico.com/news/agenda/2019/11/04/why-we-dont-know-what-to-eat-060299

147. Florko, *supra* note 145.

148. *See* Marion Nestle. *Unsavory Truth: How Food Companies Skew the Science of What We Eat* (2018).

149. Mozaffarian, D., Rosenberg, I., & Uauy, R. (2018). History of modern nutrition science—Implications for current research, dietary guidelines, and food policy. *BMJ, 361*, k2392. https://doi.org/10.1136/bmj.k2392

150. Purpose of the Dietary Guidelines. Dietary Guidelines for Americans. https://www.dietaryguidelines.gov/about-dietary-guidelines/purpose-dietary-guidelines

151. *See, e.g.,* Elizabeth Cooney. "Dietary experts advise skipping guidelines on ultra-processed foods — for now." (Oct. 21, 2024), STAT, https://www.statnews.com/2024/10/21/ultra-processed-foods-more-data-needed-before-new-federal-dietary-guidelines/?utm_campaign=twitter_organic&utm_source=twitter&utm_medium=social

152. Letter to the 2025 Dietary Guidelines Advisory Committee from the Consumer Federation of America, Appendix 1 (September 25, 204). https://consumerfed.org/wp-content/uploads/2024/09/Consumer-Federation-of-America-Comments-to-DGAC-re-UPFs-9-24-24.pdf

153. Dietary Guidelines for the Belgian Adult Population, (June 2019). Superior Health Council. https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/20190902_shc-9284_fbdg_vweb.pdf

154. Consumer Survey: Public Perceptions of Processed Foods In a Healthy Diet. (2024). International Food Information Council. https://ific.org/media-information/press-releases/the-processed-foods-paradox/

155. *See, e.g.* Gibney MJ. Ultra-processed foods in public health nutrition: the unanswered questions. *British Journal of Nutrition.* 2023;129(12):2191-2194. doi:10.1017/S0007114522002793. Defenders of the Nova classification have criticized Gibney and his co-researchers for failing to disclose funding from food corporations such as Nestlé. Joao Peres. "Big Food targets Brazilian researcher." *O joio e o trigo.* (English translation), Dec. 19, 2017 https://ojoioeotrigo.com.br/2017/12/ultra-attack-brazilian-researcher-targets-transnational-food/

156. CFA Letter, *supra* note 152

157. Bernstein, L., Weber, L., & Keating, D. (2024, October 17). How Lunchables ended up on school lunch trays. *Washington Post.* https://www.washingtonpost.com/health/interactive/2023/lunchables-school-lunch-ultraprocessed-foods/

158. Wethington, H. R., et al (2020). Healthier Food and Beverage Interventions in Schools: Four Community Guide Systematic Reviews. *American Journal of Preventive Medicine, 59*(1), e15–e26. https://doi.org/10.1016/j.amepre.2020.01.011

159. Taillie, L.S.; Hall, M.G.; Popkin, B.M.; Ng, S.W.; Murukutla, N. Experimental Studies of Front-of-Package Nutrient Warning Labels on Sugar-Sweetened Beverages and Ultra-Processed Foods: A Scoping Review. Nutrients 2020, 12, 569. https://doi.org/10.3390/nu12020569

160. *See, e.g.*, Deschasaux et al. (2020). "Association between nutritional profiles of foods underlying Nutri-Score front-of-pack labels and mortality: EPIC cohort study in 10 European countries." *BMJ. 370*:m3173. PMID:32938660.

161. *See* https://www.help.senate.gov/chair/newsroom/press/news-sanders-and-booker-take-on-food-and-beverage-industry-with-new-legislation-to-address-childhood-diabetes-and-obesity-epidemics

162. Mora-Plazas M, Aida Higgins IC, Gomez LF, Hall M, Parra MF, et al. (2022) Impact of nutrient warning labels on choice of ultra-processed food and drinks high in sugar, sodium, and saturated fat in Colombia: A randomized controlled trial. *PLOS ONE 17*(2): e0263324. https://doi.org/10.1371/journal.pone.0263324

163. McGuire S. Institute of Medicine. (2012). Front-of-Package Nutrition Rating Systems and Symbols: Promoting Healthier Choices. Washington, DC: The National Academies Press. *Adv Nutr. 2012 May 1;3(3):332-3.* doi:10.3945/an.112.001933

164. Taillie, L. S., Bercholz, M., Popkin, B., Rebolledo, N., Reyes, M., & Corvalán, M. C. (2023). *Decreases in purchases of energy, sodium, sugar, and saturated fat three years after implementation of the Chilean Food Labelling and Marketing Law* (p. 2023.11.21.23298789). medRxiv. https://doi.org/10.1101/2023.11.21.23298789

165. Reyes, M., Taillie, L. S., Popkin, B., Kanter, R., Vandevijvere, S., & Corvalán, C. (2020). Changes in the amount of nutrient of packaged foods and beverages after the initial implementation of the Chilean Law of Food Labelling and Advertising: A nonexperimental prospective study. *PLOS Medicine, 17*(7), e1003220. https://doi.org/10.1371/journal.pmed.1003220

166. Front-of-package labels around the world (March, 2024). Global Food Research Program. https://www.globalfoodresearchprogram.org/wp-content/uploads/2022/07/GFRP-UNC_FOPL_maps_2024_03.pdf

167. See Biden-Harris Administration National Strategy on Hunger, Nutrition, and Health [Executive Summary]. https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/27/executive-summary-biden-harris-administration-national-strategy-on-hunger-nutrition-and-health/

168. Redman, R. (2024, July 18). *FDA deputy commissioner outlines broad, near-term nutrition agenda*. Food Business News. https://www.foodbusinessnews.net/articles/26438-fda-deputy-commissioner-outlines-broad-near-term-nutrition-agenda

169. Lammi, G. (2024, April 6). *FDA Lacks Statutory Authority to Mandate Front-of-Pack Nutrition Labeling*. Washington Legal Foundation. https://www.wlf.org/2024/04/05/publishing/fda-lacks-statutory-authority-to-mandate-front-of-pack-nutrition-labeling/

170. *Widespread Support for Mandatory Front-of-Package Labeling in the United States*, (April 5, 2023). Center for Science in the Public Interest. https://www.cspinet.org/sites/default/files/2023-04/FOPNL%20Public%20Opinion%20Fact%20Sheet_final.pdf

171. Reiley, L. (2023, July 14). Despite warnings, sweeteners are creeping into foods aimed at kids. *Washington Post*. https://www.washingtonpost.com/business/2023/07/14/artificial-sweeteners-kids-foods/

172. Popkin, B. M., Miles, D. R., Taillie, L. S., & Dunford, E. K. (2024). A policy approach to identifying food and beverage products that are ultra-processed and high in added salt, sugar and saturated fat in the United States: A cross-sectional analysis of packaged foods. *Lancet Regional Health - Americas, 32*, 100713. https://doi.org/10.1016/j.lana.2024.100713

173. *See* Zauderer v. Office of Disc. Counsel | 471 U.S. 626 (1985).

174. Program. (2024, March 28). *Use of the Term Healthy on Food Labeling*. U.S. Food and Drug Administration; FDA. https://www.fda.gov/food/food-labeling-nutrition/use-term-healthy-food-labeling

175. Letter to U.S. Food and Drug Administration Commissioner, Robert Califf, from the Consumer Federation of America on the Proposed Rule on Nutrient Content Claims and Definition of Term "Healthy," (February 15, 2023). https://consumerfed.org/wp-content/uploads/2023/02/CFA-commends-FDA-for-revisions-to-healthy-claims-definition-but-urges-agency-to-go-further-2.15.23.pdf

176. Galligan, T. (2023, May 18). *Majority of Californians support warning labels for foods with harmful synthetic dyes*. Center for Science in the Public Interest. https://www.cspinet.org/blog/majority-californians-support-warning-labels-foods-harmful-synthetic-dyes

177. *California urged to adopt warning labels on synthetically dyed foods and supplements*. (2022, December 8). Center for Science in the Public Interest. https://www.cspinet.org/press-release/california-urged-adopt-warning-labels-synthetically-dyed-foods-and-supplements

178. *See generally* Scotter, M. J. (2011). Emerging and persistent issues with artificial food colours: Natural colour additives as alternatives to synthetic colours in food and drink. *Quality Assurance and Safety of Crops & Foods, 3*(1), 28–39. https://doi.org/10.1111/j.1757-837X.2010.00087.x. The feasibility of reformulating these products to eliminate additives of concern is made plain by a comparison of the ingredients in popular food products such as Skittles (titanium dioxide) candy, Mountain Dew (Yellow 5) soda, and M&M's (Red 40) candy posted online by a U.S. retailer (e.g. Safeway, www.safeway.com) versus the same products sold by British food retailers (e.g. Tesco, www. Tesco.com), which do not contain the additives of concern.

179. *Online Grocery Shopping Statistics (2024): Sales + Growth Rate*. (July 1, 2024). Capital One Shopping. https://capitaloneshopping.com/research/online-grocery-shopping-statistics/

180. Letter to U.S. Food and Drug Administration Acting Commissioner, Janet Woodcock, from the Consumer Federation of America on the New Era of Smarter Food Safety Summit on E-Commerce; Public Meeting; Request for Comments, (November 19, 2021). https://consumerfed.org/wp-content/uploads/2021/11/CFA-Asks-FDA-to-Clarify-Rules-Step-Up-Enforcement-for-Online-Food-Vendors-11-19-21.pdf

181. Letter to Alcohol and Tobacco Tax and Trade Bureau from the Consumer Federation of America on Labeling and Advertising of Wine, Distilled Spirits, and Malt Beverages with Alcohol Content, Nutritional Information, Major Food Allergens, and Ingredients, (March 29, 2024). https://consumerfed.org/wp-content/uploads/2024/03/CFA-comments-to-TTB-3-28-2024.pdf

182. Caramel color in Soda may be a health risk. (2014, February 10). Consumer Reports. https://www.consumerreports.org/cro/news/2014/01/caramel-color-the-health-risk-that-may-be-in-your-soda/index.htm

183. *Total spending on USDA's food and nutrition assistance programs fell in fiscal year 2023*. (2024, July 22). U.S. Department of Agriculture. http://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=58388

184. Mande, J., & Flaherty, G. (2023). Supplemental Nutrition Assistance Program as a health intervention. *Current Opinion in Pediatrics, 35*(1), 33. https://doi.org/10.1097/MOP.0000000000001192

185. Jones, J. (2024, June 12). SNAP *Spending Rose and Fell With Pandemic-Era Changes to Benefit Amounts*. U.S. Department of Agriculture. https://www.ers.usda.gov/amber-waves/2024/june/snap-spending-rose-and-fell-with-pandemic-era-changes-to-benefit-amounts/

186. *Food Prices and Spending*. U.S. Department of Agriculture. https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/food-prices-and-spending/

187. Hagstrom, J. (2024, July 11). House Approps passes ag bill that kills SNAP pilot. *Tri-State Livestock News*. https://www.tsln.com/news/house-approps-passes-ag-bill-that-kills-snap-pilot/

188. *FRAC Strongly Opposes SNAP Nutrition Security Act, Calls for More Adequate SNAP Benefits*. (2023, August 10). Food Research & Action Center. https://frac.org/news/nutritionsecurityactaugust2023

189. John, S., Melendrez, B., Leng, K., Nelms, A., Seligman, H., & Krieger, J. (2023). Advancing Equity in the Farm Bill: Opportunities for the Gus Schumacher Nutrition Incentive Program (GusNIP). Nutrients, 15(23), Article 23. https://doi.org/10.3390/nu15234863

190. Petimar, J., Moran, A. J., Grummon, A. H., Anderson, E., Lurie, P., John, S., Rimm, E. B., & Thorndike, A. N. (2023). In-Store Marketing and Supermarket Purchases: Associations Overall and by Transaction SNAP Status. *American Journal of Preventive Medicine, 65*(4), 587–595. https://doi.org/10.1016/j.amepre.2023.02.029

191. L. Harris, J., Webb, V., J. Sacco, S., & L. Pomeranz, J. (2020). Marketing to Children in Supermarkets: An Opportunity for Public Policy to Improve Children's Diets. *International Journal of Environmental Research and Public Health, 17*(4), 1284. https://doi.org/10.3390/ijerph17041284

192. John, S.; Johnson, J.; Nelms, A.; Bresnahan, C.; Tucker, A. C.; Wolfson, J. (October 2023). Recommendations to Promote Healthy Retail Food Environments. Center for Science in the Public Interest. https://www.cspinet.org/sites/default/files/2023-10/CSPI_RetailPolicyReco_2023_FINAL.pdf

193. *Store Eligibility Requirements*. (2024, September 9). U.S. Department of Agriculture. https://www.fns.usda.gov/snap/retailer/eligible

194. Waxman, E., Butrica, B., Pancini, V., Echave, P., Tabb, L., & Waidmann, T. A. (2023). *Retail Food Access and Obesity Prevalence*. Urban Institute. https://www.urban.org/research/publication/retail-food-access-and-obesity-prevalence

195. *See, e.g*. https://www.politico.com/tipsheets/morning-agriculture/2016/05/congressional-black-caucus-asks-usda-to-scrap-snap-stocking-rule-epa-launches-billboard-probe-this-week-ag-approps-214311

196. 42 U.S.C. 1758(f).

197. https://www.fns.usda.gov/pressrelease/2014/009814 this link isn't working, replace with: Kenney, E. L., Barrett, J. L., Bleich, S. N., Ward, Z. J., Cradock, A. L., & Gortmaker, S. L. (2020). Impact Of The Healthy, Hunger-Free Kids Act On Obesity Trends. *Health Affairs, 39*(7), 1122–1129. https://doi.org/10.1377/hlthaff.2020.00133

198. Cohen, J.F.W.; Kesack, A.; Daly, T.P.; Elnakib, S.A.; Hager, E.; Hahn, S.; Hamlin, D.; Hill, A.; Lehmann, A.; Lurie, P.; et al. Competitive Foods' Nutritional Quality and Compliance with Smart Snacks Standards: An Analysis of a National Sample of U.S. Middle and High Schools. Nutrients 2024, 16, 275. https://doi.org/10.3390/nu16020275.

199. U.S. Department of Agriculture & U.S. Department of Health and Human Services. (2020). Dietary Guidelines for Americans, 2020-2025: 9th Edition, pg.61. Dietary Guidelines for Americans. https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf

200. Baker-Smith, C. M., De Ferranti, S. D., & Cochran, W. D. (2019). The Use of Nonnutritive Sweeteners in Children. Pediatrics, 144(5). https://doi.org/10.1542/peds.2019-2765; 13 Johnson, R. K., et al. (2018b). Low-Calorie Sweetened Beverages and Cardiometabolic Health: A Science Advisory From the American Heart Association. Circulation, 138(9)

201. Shum, B., & Georgia, S. (2021). The Effects of Non-Nutritive Sweetener Consumption in the Pediatric Populations: What We Know, What We Don't, and What We Need to Learn. Frontiers in endocrinology, 12, 625415. https://doi.org/10.3389/fendo.2021.625415

202. *See* Cohen *supra* note 198.

203. Rogers, K. (2024, September 30). California bans red No. 40 and others from school food. CNN. https://www.cnn.com/2024/08/30/health/california-food-dye-ban-schools-wellness/index.html

204. *2024–25 CNP Reimbursement Rates—Rates, Eligibility Scales, & Funding. California Department of Education*. https://www.cde.ca.gov/ls/nu/rs/rates2425.asp

205. *USDA Announces SY2023-24 Reimbursement Rates – School Nutrition Association*. (2023, July 8). School Nutrition Association. https://schoolnutrition.org/sna-news/usda-announces-sy2023-24-reimbursement-rates/

206. Sheldon, M. (2024, April 9). *States that Have Passed Universal Free School Meals (So Far)*. NYC Food Policy Center (Hunter College). https://www.nycfoodpolicy.org/states-with-universal-free-school-meals-so-far-update/

207. Cohen, J. F. W., Hecht, A. A., McLoughlin, G. M., Turner, L., & Schwartz, M. B. (2021). Universal School Meals and Associations with Student Participation, Attendance, Academic Performance, Diet Quality, Food Security, and Body Mass Index: A Systematic Review. *Nutrients, 13*(3), Article 3. https://doi.org/10.3390/nu13030911

208. Tanner, A. (2021, July 22). *The Impact of Covid-19 on Scratch Cooking in Schools*. Chef Ann Foundation. https://www.chefannfoundation.org/blog/the-impact-of-covid-19-on-scratch-cooking-in-schools/

209. *See, e.g.* http://biz.dominos.com/school-lunch/smart-slice-testimonial/; see also https://thelunchtray.com/copycat-junk-food-schools/

210. *28% of Americans Can't Cook*. (2019, September 17). Tufts University Health & Nutrition Letter. https://www.nutritionletter.tufts.edu/general-nutrition/28-of-americans-cant-cook/

211. Belluz, J. (2024, September 10). What really drives food cravings [Newsletter]. *Julia Belluz*. https://juliabelluz.substack.com/p/what-really-drives-food-cravings

212. Muzaffar, H., Metcalfe, J. J., & Fiese, B. (2018). Narrative Review of Culinary Interventions with Children in Schools to Promote Healthy Eating: Directions for Future Research and Practice. *Current Developments in Nutrition, 2*(6), nzy016. https://doi.org/10.1093/cdn/nzy016

213. Tracy Westen, *Government Regulation of Food Marketing to Children: The Federal Trade Commission and the Kid-Vid Controversy*, 39 Loy. L.A. L. Rev. 79 (2006). https://digitalcommons.lmu.edu/llr/vol39/iss1/4

214. *Id.*

215. Pomeranz, J. L., & Mozaffarian, D. (2022). Food Marketing to — and Research on — Children: New Directions for Regulation in the United States. *Journal of Law, Medicine & Ethics, 50*(3), 542–550. https://doi.org/10.1017/jme.2022.92

216. Martinez, K. (2021, February 23). Cartoon Mascots Banned from Food Packaging in Mexico to Combat Childhood Obesity. *Remezcla*. https://remezcla.com/food/cartoon-mascots-banned-food-packaging-mexico-combat-childhood-obesity/; see also Popkin et al. Towards unified and impactful policies to reduce ultra-processed food consumption and promote healthier eating. Lancet Diabetes Endocrinol. 2021 Jul;9(7):462-470. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8217149/

217. Food Marketing and Research on Kids Lacks Government Oversight. (2022, November 18). NYU. http://www.nyu.edu/content/nyu/en/about/news-publications/news/2022/november/food-marketing-and-research-on-kids-lacks-government-oversight

218. *Ultra-Processed Foods: US Consumer Trends and Preferences.* (2024, July 8). Inova Market Insights. https://www.innovamarketinsights.com/trends/ultra-processed-foods/

219. *Retail Consolidation: Crisis Across the Food Chain*. (2023, June 8). Farm Action. https://farmaction.us/2023/06/08/retail-consolidation-crisis-across-the-food-chain/

220. Inklebarger, T. (2024, March 6). *Walmart, Kroger, Costco make top three grocery retailers list*. Supermarket News. https://www.supermarketnews.com/independents-regional-grocers/walmart-kroger-costco-make-top-three-grocery-retailers-list

221. Ravandi, B., Mehler, P., Ispirova, G., Barabási, A.-L., & Menichetti, G. (2024). GroceryDB: Prevalence of Processed Food in Grocery Stores. *medRxiv*, 2022.04.23.22274217. https://doi.org/10.1101/2022.04.23.22274217

222. *See, e.g.*, https://www.dollargeneral.com/c/food-beverage

223. Pan, A., & Hu, F. B. (2011). Effects of carbohydrates on satiety: Differences between liquid and solid food. *Current Opinion in Clinical Nutrition & Metabolic Care, 14*(4), 385. https://doi.org/10.1097/MCO.0b013e328346df36

224. Sundborn, G., Thornley, S., Merriman, T. R., Lang, B., King, C., Lanaspa, M. A., & Johnson, R. J. (2019). Are Liquid Sugars Different from Solid Sugar in Their Ability to Cause Metabolic Syndrome? *Obesity, 27*(6), 879–887. https://doi.org/10.1002/oby.22472

225. *Get the Facts: Sugar-Sweetened Beverages and Consumption*. (2022, April 11). Centers for Disease Control and Prevention. https://www.cdc.gov/nutrition/data-statistics/sugar-sweetened-beverages-intake.html

226. Sowa, P. M., Keller, E., Stormon, N., Lalloo, R., & Ford, P. J. (2019). The impact of a sugar-sweetened beverages tax on oral health and costs of dental care in Australia. *European Journal of Public Health, 29*(1), 173–177. https://doi.org/10.1093/eurpub/cky087

227. Krieger, J., Magee, K., Hennings, T., Schoof, J., & Madsen, K. A. (2021). How sugar-sweetened beverage tax revenues are being used in the United States. *Preventive Medicine Reports, 23*, 101388. https://doi.org/10.1016/j.pmedr.2021.101388

228. Kaplan, S., White, J. S., Madsen, K. A., Basu, S., Villas-Boas, S. B., & Schillinger, D. (2024). Evaluation of Changes in Prices and Purchases Following Implementation of Sugar-Sweetened Beverage Taxes Across the US. JAMA Health Forum, 5(1), e234737. https://doi.org/10.1001/jamahealthforum.2023.4737

229. Lee, Y., et al (2020). Health Impact and Cost-Effectiveness of Volume, Tiered, and Absolute Sugar Content Sugar-Sweetened Beverage Tax Policies in the United States: A Microsimulation Study. *Circulation, 142*(6), 523–534. https://doi.org/10.1161/CIRCULATIONAHA.119.042956

230. O'Connor, A., & Sanger-Katz, M. (2018, June 27). California, of All Places, Has Banned Soda Taxes. How a New Industry Strategy Is Succeeding. *The New York Times*. https://www.nytimes.com/2018/06/27/upshot/california-banning-soda-taxes-a-new-industry-strategy-is-stunning-some-lawmakers.html

231. Sugary Drinks Tax Act of 2021, H.R. 2772, 117th Congress. https://www.congress.gov/bill/117th-congress/house-bill/2772/text

232. *Perspectives on Marketing, Self-Regulation, and Childhood Obesity*. The Federal Trade Commission Department on Marketing, Self-Regulation, and Childhood Obesity (July 15, 2005). https://www.ftc.gov/system/files/documents/public_events/114026/transcript_050715.pdf

233. Senator Ron Johnson. (2024, September 30). *Make America Healthy Again*. Washington Reporter. https://washingtonreporter.news/op-ed/op-ed-sen-ron-johnson-make-america-healthy-again/

234. Make America Healthy Again. https://www.maha.vote

235. *See, e.g.*, Sarah Jones. "Trump's 'Make America Healthy Again' Is a Ruse." *New York Magazine* (Sept. 6, 2024), *available at*: https://nymag.com/intelligencer/article/trump-robert-f-kennedy-jr-health-ruse.html

236. Vogel, C., Abbott, G., Ntani, G. et al. Examination of how food environment and psychological factors interact in their relationship with dietary behaviours: test of a cross-sectional model. Int J Behav Nutr Phys Act 16, 12 (2019). https://doi.org/10.1186/s12966-019-0772-y

consumerfed.org