# Ultra-processed foods in human health: a critical appraisal

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**ABSTRACT**

The NOVA classification of foods proposes 4 categories: unprocessed or minimally processed foods, processed culinary ingredients, processed foods, and ultra-processed foods and drinks (UPFDs). It is argued that the latter relies heavily on modifications to foods, resulting in enhanced amounts of salt, added sugar, and fat as well as the use of additives in an attempt to make this food category highly palatable. It further argues that controlling food processing, rather than examining nutrients, should be foremost in shaping nutrition policy. This commentary challenges many of the basic arguments of using the NOVA food classification system to examine the link between food and health. We believe that there is no evidence to uphold the view that UPFDs give rise to hyperpalatable foods associated with a quasi-addictive effect and that the prevailing European Union and US data fail to uphold the assertion that UPFDs, which dominate energy intake, give rise to dietary patterns that are low in micronutrients. With regard to the use of the NOVA food classification in the development of food-based dietary guidelines, we show that the very broad definition of UPFDs makes this impossible. Finally, the available evidence does not support the view that the globalization of food is the driver of increased intakes of UPFDs in low- to middle-income countries but rather that this is driven by small indigenous companies. On balance, therefore, there seems to be little advantage from the use of the NOVA classification compared with the current epidemiologic approach, which relies on the linkage of nutrient intakes to chronic disease with subsequent identification of foods that merit consideration in public health nutrition strategies. *Am J Clin Nutr* 2017;106:717–24.

**Keywords:** ultra-processed, food, health, NOVA classification, food classification, food-based dietary guidelines

## INTRODUCTION

In recent years, the concept of introducing a food classification and coding system based on the degree of processing has been strongly advocated (1). One such classification system, known as "NOVA," has grown in influence in the last few years. The 4 food categories outlined in this system are as follows: unprocessed or minimally processed foods, processed culinary ingredients, processed foods (PFs), and ultra-processed foods and drinks (UPFDs). This food classification approach has been incorporated into major international reports on diet and health (2) and has also been adopted by national governments within their policies on food-based dietary guidelines (3). In most such reports, the advice has been that *1*) UPFDs should be avoided and *2*) the intake of PFs should be minimized. In addition, advocates of the NOVA food classification are critical of existing food categorizations, claiming that they are outdated and that their use in nutritional epidemiology focuses unnecessarily on nutrients and ignores the putative major impact of food processing, including the use of food additives on health and well-being. This marks a major departure from conventional approaches to the study of diet and chronic disease, and thus a critical review of the arguments that promote a focus on food processing as a major element in the diet and health equation would seem to be justified. The present commentary sets out to provide a critical appraisal on this approach.

## NOVA FOOD CODING AND CLASSIFICATION SYSTEM

The NOVA classification of foods requires that users interpret the proposed definition of UPFDs to determine which foods belong to each of the 4 classes of the NOVA system. UPFDs are defined as follows: "Formulations of several ingredients which, besides salt, sugar, oils, and fats, include food substances not used in culinary preparations, in particular, flavours, colours, sweeteners, emulsifiers and other additives used to imitate sensorial qualities of unprocessed or minimally processed foods and their culinary preparations or to disguise undesirable qualities of the final product" (4). This linguistic definition poses problems

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Abbreviations used: EU, European Union; PCA, principal components analysis; PF, processed food; UPFD, ultra-processed food and drink.

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for defining foods according to the NOVA classification. The term "formulations" is open to many interpretations. The reference to salt, sugar, and fat lacks cutoffs per gram, per portion size, or per unit of energy; and the reference to food additives poses particular difficulty, because food additives may be legally permitted in foods but may, or may not, be present. Moreover, the user must be able to extrapolate from the presence of an additive to its use in imitating "sensorial qualities of unprocessed or minimally processed foods and their culinary preparations or to disguise undesirable qualities of the final product." In response to such queries, the NOVA classification has published lists of food types that might be included in each of its 4 categories (5). However, neither the terms used to define UPFDs nor the list of typical foods in each category of the NOVA system meet the normal standards set in established food classification. The NOVA classification system is in contrast to the very thorough food-coding methodologies that have been developed by other agencies to categorize foods and that do so to make it possible to eliminate confusion due to simple linguistic definitions, as suggested by the NOVA system. The European Food Safety Authority has developed a system (Foodex) to define foods in a way that suits all users of food-intake data from food chemical exposure to food intake for dietary purposes (6). The EPIC (European Prospective Investigation into Cancer and Nutrition) consortium has also developed a system for the direct coding of individual foods and meal components, based on their degree of food processing, and has applied this across a wide variety of cultures that are diverse in both gastronomic traditions and languages (7). The most sophisticated of the food-coding systems is that of LanguaL, which embraces a large number of descriptors for different aspects of food processing (8). The European consortium on food-composition data, Eurofir, has adapted this very sophisticated system (9). Thus, the NOVA classification is, by comparison, a rather simple and crude system of classifying foods into categories on the basis of their degree of processing and is in stark contrast to many existing food-classification systems.

## THE NOVA SYSTEM AND PUBLIC HEALTH NUTRITION STRATEGIES

Public health nutrition has been well served over the past half century by the identification of potential dietary contributors to noncommunicable chronic disease through epidemiologic research, supported by subsequent validation in human intervention studies and also by the emergence of food-based dietary guidelines that shape public health nutrition policies. The advocates of the NOVA classification system argue that the failure to shape our public health nutrition focus around the degree of food processing, as opposed to the nutritional dimension, is a major limiting factor in the area of epidemiology and related public health nutrition policies. This is articulated by Monteiro et al. (10), who stated that "the significance of industrial processing—and in particular methods and ingredients developed or created by modern food science and technology—on the nature of food and on the state of human health, is so far understated."

Although such statements have been made and published, to our knowledge no arguments have been offered as to how, or if, food processing in any way constitutes a risk to consumer health through adverse nutrient intake or chemical or microbiological hazards. The one concrete example put forward is the use of *trans* fats in PFs (11). However, not only have the adverse effects of *trans* fats been observed through standard nutritional research involving both epidemiology and dietary intervention studies, such findings and remedial action predate the concept of UPFDs by decades (12).

## NUTRITIONAL EPIDEMIOLOGY

Clearly, the application of the NOVA classification to nutritional epidemiology is secondary to any initial analysis of population food and nutrient intakes that use conventional dietary assessment methods and food-classification techniques. The post hoc grouping of foods into the NOVA classification group, subject to the coding challenges previously outlined, is the starting point to examining the impact of food consumption with the use of this classification system and its link to health. To date, this system has been primarily linked to 2 public health nutrition issues: obesity and the metabolic syndrome and its complications (13–17). However, there are clear indications that the application of this system in these areas is not without substantial research challenges and contradictory findings. For example, in contrast to the several data sets that support an association of obesity and intake of UPFDs (13–17), an analysis of the UK National Diet and Nutrition Survey shows no such role, when such analysis was corrected for known confounders of obesity (18). Because the definition of UPFDs is based on the macronutrient contents of foods, it is challenging to see how this classification could contribute to the study of dietary links to diseases that are not strongly related to overall energy intake, such as neural tube defects, cognitive growth and decline, age-related macular degeneration, sarcopenia, stunting, goiter, anemia, food allergies and intolerances, osteoporosis, nonalcoholic steatohepatitis, dental caries, microbiome-related conditions such as irritable bowel syndrome and constipation, and numerous micronutrient deficiencies and insufficiencies. For these conditions, very specific nutrients are implicated, such as folic acid, long-chain n–3 PUFAs, protein, soluble fiber, and frequency of sugar intakes, iodine, iron, and many micronutrients. In both the epidemiologic study of the role of diet in such conditions and in the subsequent application of the findings to food-based dietary guidelines, the NOVA classification is simply of no value because it cannot offer specificity at an individual nutrient level.

The NOVA system lacks in its ability to contribute to the research into overall adequacy of dietary patterns. Such overviews are currently achieved by using models such as the Healthy Eating Index or the Alternative Healthy Eating Index (19). In addition, a number of more complex statistical approaches to data analyses are used, which give greater insight into the identification of dietary patterns. These include principal components analysis (PCA), cluster analysis, data-mining techniques such a decision tree analysis or neural network analysis, fuzzy logic, optimized mixed diets, and meal pattern analysis (20–24). All of these approaches use food-intake data coded at as high a level of exactitude as is possible to understand food- and meal-intake patterns and how these may be linked to chronic disease or risk factors thereof. Such analyses are simply outside the scope of a broad classification system approach such as NOVA. To date, only one study to our knowledge has examined the existing NHANES databases by using PCA, in which nutrient intakes were used in the statistical construct and the PCA data were linked to the percentage share of UPFDs to energy intake (25). In this analysis, an inverse relation was seen between the percentage energy share of UPFDs and the PCA-derived dietary quality score.

## FOOD-BASED DIETARY GUIDELINES

Definitive recommendations on the development of food-based dietary guidelines are contained in the report of the WHO and FAO on this topic (26). The schema proposed in this report is presented in **Figure 1**. Beginning with the identification of the specific public health issue in question, and the exclusion of nondietary confounding factors, the pathway to the development of food-based dietary guidelines involves the identification of foods that are discriminatory for the nutrient in question, and then gives consideration to food availability, cultural norms, and price. The report recognizes the great variety that exists in the quality of data available to elucidate such a set of dietary guidelines for any given public health nutrition issue. At the higher end of data quality, the report advocates the use of population intakes of target foods, the percentage of consumers of these foods, and the intakes of such among consumers of the target foods. This well-established and respected approach adopted in many countries worldwide and incorporated into standard international textbooks on public health nutrition (27) is simply not possible with the use of the NOVA classification, because it is simply too broad and too rigid and is based primarily on processing as opposed to nutritional issues. All in all, the present approach to nutritional epidemiology and the development of food-based dietary guidelines has little or nothing to benefit from the use of the NOVA classification.

## INTAKES OF PFs AND NUTRITIONAL ADEQUACY

To date, most of the studies that used the NOVA classification have been limited to quantifying the contribution of UPFDs to intakes of added sugar or energy or to variations in micronutrient intakes (4, 28). That the intake of UPFDs correlates highly with added sugar intake should not be surprising because the term "added sugars" is a major defining element of the UPFD classification system. Equally, studies that track the contribution of UPFDs to energy intake should also track the food categories included or excluded in the definition of UPFDs, as has been observed. However, when the same data examine nutrient intake, increasing contributions of UPFDs to energy intake do not always track the nutrients, which might be expected to correlate with UPFD intake. For example, in one study (25), across quintiles of UPFD intake (percentage of contribution to energy intake), the percentage of energy from total fat increased from 31.4% to 32.5% of energy across the lowest to the highest quintile of UPFD intake. Equally, the data for intakes of SFAs (10.1% compared with 10.9% of energy) and sodium (1.74 compared with 1.63 mg/1000 kcal) also showed marginal changes. Although these differences were significant, they are marginal in terms of impact on public health nutrition targets. These data thus show that UPFDs may track individual foods within that category, but they do not strongly discriminate intakes of fat and salt.

When micronutrient intakes are examined across NOVA food classifications, UPFDs are seen to be less micronutrient dense than minimally processed foods (4). However, studies that examined the sources of micronutrient intake in the United States showed that the foods that are enriched or fortified play as important a role in micronutrient intake as that of intakes of micronutrients that naturally occur in foods and that variation in PF intake does not create nutritional imbalances (29, 30). Of

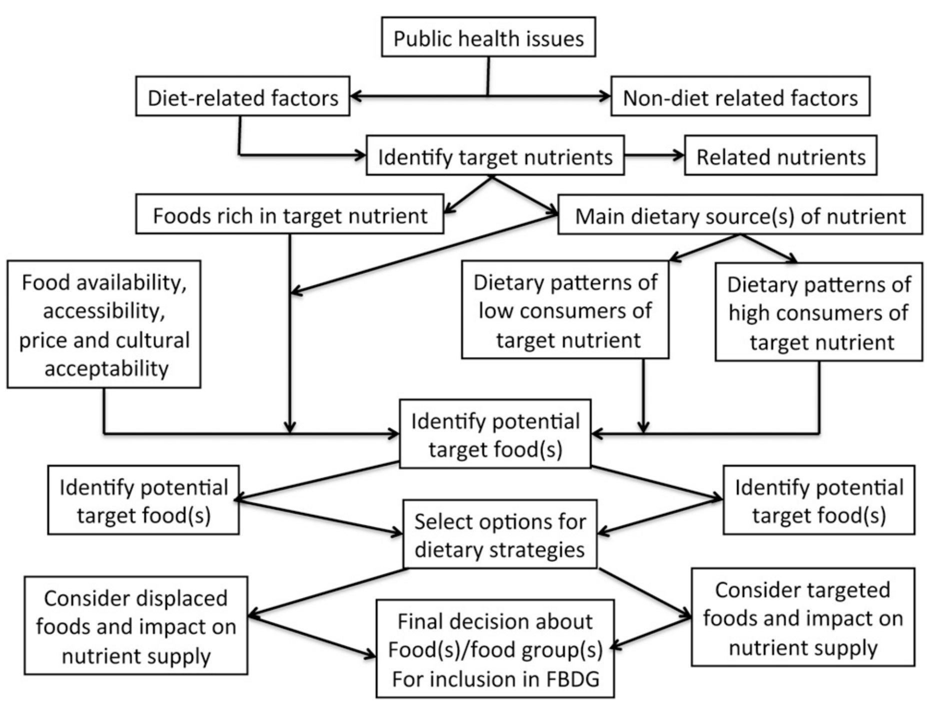


**FIGURE 1** Schematic representation of the FAO/WHO recommendations for the development of food-based dietary guidelines. FBDG, food-based dietary guidelines.

considerable importance in this context are the findings of the EPIC study of the nutritional adequacy of diets and the role of food processing (7). This study examined the diets of 36,000 adults aged 35–75 y by using a 24-h recall method specifically designed to incorporate data on food processing for all individual foods and meal components applied to the point of collection and recording of each individual's data. The results showed that all "highly processed foods" accounted for approximately two-thirds of energy intake and most micronutrient intakes.

Finally, this issue has also been looked at from a different perspective in which the capacities of nonprocessed foods to meet nutritional requirements have been examined. In this instance, the optimal erythrocyte concentrations of folic acid commensurate with a reduced risk of a neural tube defect birth could not be achieved by using unprocessed foods and were achieved only when folic acid–fortified foods or food supplements were used (31). This finding has subsequently been supported by dietary survey data analysis looking at erythrocyte folic acid and intakes of nonfortified foods and tertiles of folic acid–fortified foods and of food supplements (32). Thus, the balance of data does not support the assertion of the advocates of the NOVA food classification that UPFD intakes lead to inadequate micronutrient intakes.

## UPFDs IN THE REGULATION OF FOOD INTAKE

The literature on UPFDs proposes that such foods may be hyperpalatable, promote food addiction, and have a lower capacity to induce satiety (33). For example, the Pan American Health Organization, in its recent report, stated the following: "Ultra-processed products are designed to satiate food cravings, they are often hyper-palatable and habit forming, and sometimes even quasi-addictive. Certain characteristics (tastes, properties, etc.) engineered into these types of products through food science and other technologies can skew mechanisms in the digestive system and brain that signal satiety and control appetite, and cause overconsumption" (2). However, the evidence in support of the claim that UPFDs are less satiating is sparse and inconclusive, with the only comparison to date based on a crude satiety index compiled for a limited number of foods for their 2-h satiating effect (33, 34). To date, there are no studies to our knowledge that have compared the satiating efficiency of minimally processed and ultra-processed versions of the same food material (commodity) on a calorie-for-calorie basis for established markers of appetite and satiety. Higher energy-dense foods are less satiating calorie for calorie than are lower energy-dense foods (35), and certain aspects of food processing often lead to increases in energy density through techniques such as adding sugar or deep frying, and increased energy density has been shown to promote passive overconsumption and increased body weight (36). However, food processing and reformulation are also widely applied to reduce energy density, as evidenced in semi-skimmed milk, low-fat spreads, preportioned calorie-controlled meals, or zero-energy beverages. Comprehensive meta-analyses have concluded that when used to replace sugar-sweetened beverages, nonnutritive sweeteners can significantly contribute to a reduction in energy intake and body weight (37). Covert manipulation of a food's energy density has been shown to both increase and decrease acute energy intakes (38, 39). Food reformulation and processing has given rise to a wide variety of products that vary in energy density and provides options for consumers to select the calorie content of the products they choose to consume. Data from the United Kingdom show that across 80 types of chocolate chip cookies there is a variation in energy density ranging from 2.63 to 5.21 kcal/g, whereas across 70 versions of pepperoni pizza, energy density ranges from 500 to 2000 kcal/serving (40). Food processing and reformulation can support dietary energy density reduction by giving consumers calorie options within a category, and calorie-controlled products such as prepared meals have been shown to be beneficial in supporting consumers to lose and maintain weight loss (41). By contrast, it has also been suggested that dietary variability may impair the predictive accuracy of visual and sensory cues to signal the energy content of specific foods, although the extent to which this variability affects energy intake remains unclear (42).

The term "food processing" encompasses a very broad range of approaches to manipulating raw ingredients in the manufacture of consumer goods. Processes such as mixing, extrusion, or heating can destroy a food's natural cell wall structures and, in many cases, processing produces softly textured foods that are eaten quickly and promote energy intake (43). Equally, food processes can be used to increase food texture by adding crunch, chewiness, and firmness, which encourages chewing and a slow eating rate and supports decreased energy intake (44, 45). Understanding how food processing influences food structure and texture can aid in the development of foods with increased satiation and satiety per calorie consumed (46).

The term "hyperpalatability" has been used to describe sensory combinations of UPFDs that override the body's and brain's natural satiation mechanisms to promote excess consumption (47). Combinations of fat, salt, and sugar that are today described as hyperpalatable are not new phenomena, because today's PFs are designed to take advantage of the same adaptive food preferences that have evolved over many centuries to ensure a ready supply of essential energy, protein, or electrolytes needed for survival. These are not new "appetites," because even preindustrial food production catered to these food preferences from the production of bread from wheat to the desire to consume the earliest pizza. There is little evidence to suggest that hyperpalatability is a distinct phenomenon from "palatability," and in this regard, hyperpalatability is an unlikely candidate to explain the relatively recent increase in obesity or the proposal that modern foods and food preferences promote addictive eating behaviors. Much of the evidence presented to support claims on hyperpalatability and addiction has been based on rodent feeding models, with little consideration for the complexity of the human food system or the social and cognitive factors that influence everyday eating behaviors. The likelihood that PFs act as addictive substances is further challenged when we compare differences in food and drug addiction (48). Although both can activate similar reward pathways in the brain, when drugs and food are compared there remain distinct differences in both the potency and effect of the associated drug and food stimuli. Food addiction is unsupported by existing neurobiological evidence (49), and "addiction" is an inappropriate term to universally describe the eating behavior of millions of overweight and obese people worldwide, with the exception perhaps of a specific overeating phenomenon that is best described as binge eating (50). The European Union (EU) NeuroFAST Consortium, which seeks to investigate the neurobiological drivers of eating behavior, addiction, and stress, in its consensus opinion states that "the current evidence does not suggest a single food via a single neurobiological mechanism that can account for the fact that people overeat and develop obesity. With the exception of caffeine and alcohol, no food or beverage can cause a substance based type of addiction" [cited from (51)]. Importantly, food addiction may harm efforts to reduce overconsumption by endorsing the concept that a person is free to view his or her behavior as that of an addict where they have little control over the impulse to eat or effect a dietary change. A recent study showed that simply endorsing that food addiction is true can encourage people to self-diagnose as food addicts and justify maladaptive eating behaviors accordingly (52). Describing excess habitual energy intakes as food addiction contributes little to a basic understanding of the mechanisms and etiology of obesity and offers little guidance in terms of effective strategies to reduce it. The balance of evidence does not support the proposal that UPFDs induce passive overconsumption of energy by skewing of "mechanisms in the digestive system and brain that signal satiety and control appetite, and cause overconsumption" [cited from (47)]. Rather than attributing energy intake solely to the degree of food processing, a more likely feature of modern diets that promotes increased energy intakes is the combination of increased food portion size and energy density, in which evidence from human and rodent studies clearly supports a role for both in promoting energy consumption (53). In this regard, the NOVA classification system neglects the potential for food processing and reformulation to be applied to increase or decrease energy and nutrient contents of modern foods.

## UPFDs AND GLOBAL FOOD SYSTEMS

The ubiquitous spread of PFs and the decline of traditional gastronomic practices have raised the concern that an increasingly palatable, convenient, and cheap food supply will inevitably undermine optimal dietary habits. The globalization of the food chain is almost always associated with large transnational food corporations. This raises the issue of the capacity to curb the economic forces of such corporations by those advocating the NOVA approach to food classification: "The scale and power of the corporations whose profits depend on these products is colossal. Realistic policies and actions to check or reduce their consumption will go beyond education and information programmes and will be centred on fiscal and other statutory measures" (54). However, the available data, while recognizing the contribution of the multinational food corporations to the changing food supply, also show that the dominant suppliers of packaged, and thus mainly processed, foods are, in fact, small- to medium-sized enterprises (52). The global market for PFs is valued at \$3.2 trillion, accounting for three-quarters of the global food market. Nonetheless, only 10% of processed packaged food sales are considered "traded products," that is, traded internationally. In effect, 90% of PFs are part of the indigenous food economy. Of the 10% that are traded internationally, the United States, the EU, and the rest of the world each account for one-third of such trade (55). Studies have shown that large multinational companies, while sustaining a high profile and attracting considerable mass and social media attention, actually make a minor contribution globally to food intake. One study concluded the following: "Although the top 10 soft drink companies account for half of global sales, the top 10 packaged food companies account for only a small proportion of market share with most individual companies contributing less than 3.3% each. Major multinational companies need to be joined by the myriad of small- and medium-sized enterprises in developing and implementing programs to improve the health of the public, globally" (56). Thus, the popular concept of transnational food corporations dominating the global food supply is open to question, as is the overall impact of globalization on diet-related public health issues. Although globalization is generally seen as a commercial and economic activity, the field recognizes that there are 2 other major drivers of globalization. One is the globalization of communication through social media, which allows consumers in one part of the world to be informed of policy decisions elsewhere in the world. This communications route can have a major impact on local political and consumer activity. The second is governmental globalization, which in the case of food and health involves the UN agencies such as WHO, UNICEF, Codex Alimentarius, and the like but also nongovernmental organizations such as the World Obesity Federation or the World Cancer Research Fund. Such agencies drive nutrition policy over and above what might be driven at a national or local level.

Globalization and its relation to mean adult BMI were examined in one study that used data from 127 countries. Regression analyses showed that the global increase in BMI over time was positively correlated with economic globalization. This study also showed that global BMI variation was equally associated with measures of economic inequality between countries (57). A second study examined globalization and its role in obesity in ≤887,000 women aged 15–49 y living in 56 countries between 1991 and 2009. The results showed that obesity was influenced by globalization, but the impact of economic globalization was far less than that of political and social globalization (58). Finally, the most recent study looked at globalization in relation to obesity in children aged 2–19 y. This particular study showed that all indicators of economic globalization were, in fact, negatively correlated with childhood obesity, leading the authors to conclude that "local level factors possibly matter much more than do global-level factors for explaining why some people remain thin and others put on weight" (59). Together, these data on globalization and on the relative roles of indigenous small- to medium-sized enterprises and transnational corporations simply serve to illustrate the complexity of modern food systems and that what often seems intuitively obvious is not necessarily so. UPFDs are thus not primarily confined to global trade but to a greater extent are attributable to local economic forces. This does not in any way diminish the need to explore how industrially prepared foods might be reformulated to enhance their nutritional qualities and their capacity to contribute to healthy eating.

## CONCLUDING THOUGHTS

The advocates of NOVA intend to have their system adopted at the highest level of international focus and seek that the production and consumption of these products (UPFDs) be confronted, checked, and reversed as part of the work of the UN Sustainable Development Goals and the UN Decade of Nutrition (60). They cite 5 reasons why their case is valid. The first focuses on their assumption that existing food-coding systems are inadequate, and they argue that the community that collects dietary data codes such data in a way that foods with different health effects are combined. They argue, for example, that “cereals and cereal products” often group whole grains together with sugared breakfast cereals and cookies (biscuits). This is not true for the vast majority of known databases, which define food intake at its basic level according to tables of food composition. For the USDA, entering the term “breakfast cereal” yields 10 options each with a unique nutrient composition to allow the end user to make further definitions such as high-fiber, low-salt, or low-sugar cereals. Entering the term “wholegrain breakfast cereal” elicits 15 items, whereas “wholegrain breakfast bar” elicits 29 items. This is typical of modern food-composition databases, and much of the credit globally for the development of this essential tool in public health nutrition must go to the FAO international initiative, INFOODS. To perpetuate the myth that the modern approach to food classification is both static and outdated is both untrue and irresponsible. NOVA food classification would benefit from a more detailed analysis of patterns of intake of foods that make up the various categories proposed by this system. It would be informative to know what percentage of the population consume each of the foods within the UPFD food category and the actual intake of foods among consumers only as advocated by global agencies. It would also be valuable to explore similar data for various combinations of foods to allow a greater understanding of meal-pattern analysis. Such subclassification would also allow some degree of research into appetite and satiety aspects of different PFs. At present, there are far more pressing doubts about the basis of the NOVA food classification system than hard data to better understand the role of such a system in public health nutrition.

The second justification of the NOVA system, as raised in the request for inclusion in the UN Decade of Nutrition, relates to food processing, and the example the authors give is the use of hydrogenated fats in the human diet. These are industrial products known through human nutrition experimentation to increase LDL cholesterol and lower HDL cholesterol. Such information first came to light in 1990 and in 1994; EU companies began a successful campaign to eliminate *trans* fats completely from their products. In 2015, the United States decided to do likewise, but sweeping reductions in the use of *trans* fats had already been made (61). Thus, this one effect of processing is no longer regarded as a threat to human cardiovascular health (62). That the NOVA advocates did not mention one example of more recent food additives speaks volumes of the absence of any adverse data on human health from food additives. In doing so, they also missed the opportunity to highlight how fat and oil technologies gave rise to margarines, spreads, vinaigrettes, dressings, and creams with varying fat contents and fatty acid compositions to aid consumers in optimizing their food choice, and health benefits.

Their remaining 3 criticisms of the modern food supply are built around the role of transnational corporations in reshaping traditional diets with the advent of global trade and the growth of modern supermarket. These have been challenged in this critique, and the proponents of NOVA must acknowledge the dominant contribution that the local, indigenous food industry makes to the food chain across the globe.

Finally, the proponents of NOVA, in advocating the avoidance of UPFDs and the reduction in PF intake, must recognize that they have a duty to verify that such a move is within the resources of ordinary families in order to address issues of nutritional security. Given the observed significance of the contribution of PFs to macro- and micronutrient intake, it would seem unwise to endorse the NOVA recommendation that the intake of UPFDs should be avoided and that the intake of PFs should be minimized. To date, to our knowledge, no data have been presented with regard to the positive or negative outcomes of such a strategy among free-living subjects. To our knowledge, no data exist with regard to the average consumer’s ability in terms of income, culinary skills, available culinary facilities, and time or food availability to uphold the case that the abandonment of UPFDs would significantly alter nutritional well-being. Without such data, there may be some ethical issues that would need to be considered before the mass abandonment of UPFD intake is recommended.

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