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Forum

Eliminate or reformulate ultra-processed foods? Biological mechanisms matter

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Increased ultra-processed foods (UPFs) in the food supply have plausibly caused the rise in obesity prevalence and related chronic diseases. To address this public health concern, policies targeting reformulation or elimination of UPF categories will require improved understanding of the biological mechanisms whereby UPFs lead to overconsumption and poor health.

Nutrition science seeks to comprehend the influence of diet, with all its complexities, on human physiology and health. Classifying foods by their nutrient composition (e.g., sodium, fiber, saturated fat, added sugars) has been useful for understanding nutritional physiology as well as informing dietary recommendations and guidelines. But the classical nutrient-centric view was recently challenged by a new classification system called NOVA that categorizes foods according to their purpose and extent of processing, largely ignoring their nutritional content (Monteiro et al., 2019).

The NOVA system partitions foods into four progressively processed categories, with the highest category labeled "ultra-processed foods" (UPFs). UPFs are comprised of cheap sources of energy containing minimal whole foods. They are formulated using a series of industrial processes and include ingredients "never or rarely used in kitchens, or classes of additives whose function is to make the final product palatable or more appealing" (Monteiro et al., 2019). UPFs now represent a substantial share of overall food intake (Marino et al., 2021), with notable heterogeneity between countries and socioeconomic strata. For example, lowest intake was observed in Italy with around 10% of total kcal from UPF, and highest in US and UK with more than 50% of total kcal from UPF (Marino et al., 2021). New research based on nationally representative data indicates that US children and adolescents (ages 2–19 years) have reached an alarmingly high UPF intake that has steadily increased from 61.4% to 67.0% of total kcal over the past two decades (Wang et al., 2021).

There are several reasons why UPFs now dominate the food supply in many regions. UPFs are highly profitable, and industry employs intensive marketing campaigns to consumers, particularly aimed at children. Consumers find a wide variety of UPFs to be affordable, palatable, convenient, and shelf stable. Despite potential advantages, however, epidemiologic and experimental evidence collectively implicate that UPF intake is a risk factor for obesity, poorer cardiometabolic health, and all-cause mortality (Pagliai et al., 2021). Recent longitudinal data from children in the UK corroborate prior evidence, showing those consuming the most UPF in childhood (~68% total kcal from UPF) had greater increases in adiposity through adolescence and into young adulthood than their peers with lower UPF intake in childhood (Chang et al., 2021), by an amount similar to the overall adiposity increases in UK children over the past quarter century (NHS, 2019). One tightly controlled randomized crossover trial demonstrated that a diet high in UPFs caused excess *ad libitum* energy intake and weight gain in adults, while an unprocessed diet matched for presented calories, carbohydrate, sugar, fat, sodium, and fiber resulted in spontaneous weight loss (Hall et al., 2019). Therefore, it is plausible that the increased share of UPFs in the food supply at least in part caused the rise in prevalence of obesity in the US (and now globally).

The potential harm of UPFs has encouraged many proponents of the NOVA system to recommend avoiding UPFs entirely and to call for policies aimed at removing UPFs from the food supply. However, uniformly reducing all UPFs—the heterogeneous food category that now represents 67% of total kcal per day for US children—may not ultimately be an appropriate public health goal and may even have unintended harms. Drastically reducing or eliminating the availability of all categories of UPFs without simultaneous consideration and efforts to replace them with better, affordable, and practical alternatives should be scrutinized. Eliminating UPFs that deliver on many desirable properties (inexpensive, microbiological safety, nutrient fortification, extended shelf-life, and convenience) may only worsen the existing disparities in food insecurity.

Public health policies aimed at mitigating the health burden of UPFs should therefore acknowledge the vast heterogeneity in this group of foods and beverages and tailor strategies accordingly to maximize effectiveness and minimize harm. For example, a growing body of evidence supports taxation and/or banning sugar-sweetened beverages (SSBs) specifically to reduce their intake at a population level. SSBs are UPFs that have little nutritional value. Their consumption results in a rapid increase in circulating glucose and a substantial fructose load to the liver while providing little satiety due to their liquid form. Therefore, campaigns targeting elimination of reduction of SSBs have little downside and better, inexpensive alternatives are readily available.

However, a similarly aggressive public health policy targeting UPFs that fall into the category of ready-to-eat or heat meals would arguably be inappropriate and counterproductive. In fact, consumption of ready-to-eat or heat UPFs has more than doubled in US children in recent years (Wang et al., 2021), while over the same period the average diet quality of US children has actually modestly improved, according to the American Heart Association diet score and the Healthy Eating Index (Liu et al., 2021). Further, the increased popularity of ready-to-eat or heat UPFs also reflects important changes in food utilization and home economics. Rather than eliminating such foods, we should acknowledge their utility and consider that their reformulation, rather than elimination, might have a more meaningful impact on improving the nutritional quality and health on a population level.

Direct (e.g., mandates) and indirect (e.g., package labeling) strategies for reformulation of specific UPFs will require a solid biological understanding of how the targeted products directly impact health. Reformulating UPFs while retaining their desired properties will require knowledge of the precise components or features that elicit unhealthful effects, which will make these substitutions more effective and precise. However, at this time, mechanisms by which UPFs encourage excess energy intake and deleterious health outcomes are largely unknown—but hypotheses abound. Perhaps the sensory attributes of UPFs make them easier to chew and swallow, resulting in faster eating (Forde et al., 2020), such that overconsumption occurs before gut-brain signals have time to communicate satiation. UPFs may lead to overconsumption of calories because they are often high in sugar and fat while being low in protein. Industrial food processing can result in substantial water losses, thereby increasing their energy density, which may also result in overconsumption. It is also conceivable that the absence of a natural food matrix and the low insoluble fiber content of UPFs might disrupt interactions with microbiota or abnormal absorption and signaling from the gastrointestinal tract. Or perhaps UPFs are industrially engineered to be hyper-palatable, with ingredients that disrupt the flavor-nutrient feedback relationships that evolved over millennia (Small and DiFeliceantonio, 2019). It certainly could also be any combination of these mechanisms and more. More research is clearly required to understand precisely how UPFs contribute to overconsumption, obesity, and associated diseases. Such knowledge will be critical for designing practical and effective interventions at the individual and population levels.

In conclusion, the evidence against UPFs is sufficient to recommend that those with the means and desire to replace UPFs with less processed foods should be encouraged to do so. However, the broad NOVA classification system may be too blunt to guide public health responses to pressing epidemics such as obesity. Industrial food processing is an established and ubiquitous part of our food system, reflected by the fact that UPFs provide more than half of calories consumed in many countries. While some UPF categories (e.g., SSBs) should be targeted for reduction, policies targeting elimination of UPFs as a broad category ignore the substantial time, skill, expense, access, and effort required to safely procure enjoyable meals without UPFs—resources that are already in short supply across large swaths of the population. Alternatively, many common UPF products may be amenable to effective reformulation. More mechanistic UPF research is urgently needed to identify the precise attributes of UPFs that elicit harm and optimize effective reformulation strategies to improve human health.

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