Academy of Nutrition and Dietetics

Nutrition FACT CHECK

Ultra-Processed Foods

Ultra-processed foods (UPFs) have emerged as a growing focus in nutrition science due to increasing evidence that these foods contribute to multiple chronic diseases. As defined by the Nova classification system, UPFs are industrial formulations composed of refined ingredients, additives and minimal to no whole foods.[1] This definition encompasses a wide variety of foods from ice cream, margarines, breakfast cereals and packaged breads to tofu, soymilk and canned vegetables.[2] The appeal of UPFs is unsurprising given they are often relatively inexpensive, hyper-palatable, shelf-stable and convenient. UPF intake is also influenced by social and demographic factors including age, race and ethnicity, income, food insecurity and geographical location.[3] Consumption of UPFs has increased significantly, with UPFs contributing over 50% of total calorie intake in the United States,[3] prompting concern from public health experts, dietitians and clinicians alike.

The Nova system classifies foods based on their degree of processing; that is, from unprocessed to ultra-processed. This system has faced significant criticism due to concern for oversimplification, as the nutrient composition of foods classified as UPFs can vary greatly. Many UPFs are energy dense and high in saturated fat, salt and added sugars.[1] However, other UPFs, such as whole grain breakfast cereals, canned vegetables and beans, as well as non-fat Greek yogurts, may be considered good sources of essential nutrients.[2] UPFs also provide individuals with variety and sustenance that may otherwise not be feasible due to physical or physiological limitations. These include thickened nutritional supplements for individuals with dysphagia, gluten-free products for those with Celiac disease and soymilk for those with dairy allergies.[4] Grouping a wide variety of foods as UPFs complicates whether observed health risks are due to specific types of UPFs, their nutrient composition, their level of processing or other confounding factors, such as socioeconomic status or overall diet quality.

The Nova system is developed by the Center for Epidemiological Studies in Health and Nutrition, School of Public Health at the University of São Paulo in Brazil. The Nova system has four groups of processed foods, with group 1 being the least processed and group 4 being the most processed.

Summary and Limitations of Evidence on UPFs

Health Impacts

Observational studies have consistently linked high intakes of UPFs with adverse health outcomes. A 2024 umbrella systematic review and meta-analysis found convincing evidence that higher UPF intake was associated with increased risk of cardiovascular disease related mortality, Type 2 diabetes, as well as anxiety and other combined common mental disorder outcomes.[5] The review also found highly suggestive evidence that linked UPF intake to all-cause mortality, heart disease related mortality, depressive symptoms and obesity.[5] In contrast, weak to no evidence was found for many site-specific cancers, including breast, central nervous system, chronic lymphocytic leukemia, pancreatic and prostate cancer. Weak to no evidence also was found for conditions such as hypertriglyceridemia, low high-density lipoprotein (HDL) cholesterol levels, Crohn's disease, ulcerative colitis, hyperglycemia, metabolic syndrome and non-alcoholic fatty liver disease.[5] Additional umbrella reviews from 2025 found similar results, reinforcing associations between UPFs and all-cause mortality, cardiovascular disease incidence and mortality, Type 2 diabetes incidence and colorectal cancer.[6,7]

These reviews offer consistent evidence but important questions remain about the validity of measures used to assess UPF intake and the mechanisms driving these associations. Most studies rely on food frequency questionnaires that are not designed to classify foods based on their Nova processing level, raising concern for potential misclassifications. Additionally, associations between UPFs and health outcomes are often interpreted without fully adjusting for lifestyle factors, nutrient quantity or overall dietary patterns. Determining the specific aspects of UPFs that may be responsible for the observed effects on health is challenging. A 2024 umbrella review emphasizes that additional research is needed to understand mechanisms through which UPFs may contribute to disease risk.[5] Major hypotheses include the poor nutrient profiles of many UPFs, displacement of minimally processed foods from the diet, alterations to physical structure that impact how UPFs are consumed, exposure to potentially harmful additives or byproducts and contaminants from food packaging.[5]

Nutrients and Overall Diet Quality

Several studies have attempted to refine our understanding of how UPFs may affect health by assessing overall dietary intake. Data from the 2009-2010 National Health and Nutrition Examination Survey (NHANES) reported a decrease in average intake of protein, fiber, vitamins A, C, D and E, zinc, potassium, phosphorus, magnesium and calcium as energy intake from UPFs increased.[8] Simultaneously, higher intakes of UPFs were related to increased intake of carbohydrates, added sugar and saturated fat.[8] Despite these findings, a recent review found that adjustments for fat, sugar and sodium intake, or adjustment for adherence to a range of dietary patterns, did not change the adverse associations between UPF intake and several adverse health outcomes in multiple prospective studies.[1] A 2024 study reported that high intake of UPFs was associated with higher risk of cognitive impairment and stroke, even after adjusting for MediterraneanDASH Intervention for Neurodegenerative Delay (MIND), Dietary Approaches to Stop Hypertension (DASH) and Mediterranean diet scores amongst other covariates (including age, race, sex, smoking status, BMI, alcohol use, education and income).[9] While these methods attempt to isolate the effect of UPFs from overall dietary patterns, interpretation remains limited by how diet quality was measured. MIND, DASH and Mediterranean diet scores do not consider total energy intake or processing levels of food, and they rely on limited food groups to generate a composite score.

In contrast, a large cohort study using data from the Nurse's Health Study and Health Professionals Follow-Up Study found no consistent association between UPFs and mortality when adjusting for the Alternative Healthy Eating Index-2010 (AHEI) score.[10] Further, when UPFs were divided into subcategories, meat- poultry- and seafood-based ready-to-eat foods showed a particularly strong association with mortality outcomes, followed by sugar-sweetened and artificially sweetened beverages, dairy-based desserts and ultra-processed breakfast foods. A 2024 populationbased cohort study conducted sensitivity analysis of the above data and showed that including whole grain UPFs weakened the association, suggesting a protective effect.[10] Similarly, a meta-analysis conducted in 2024 found that UPF subgroups of cereals and breads and packaged savory snacks were inversely associated with Type 2 diabetes risk.[11]

Effects of Processing

While part of the risk associated with UPFs may be attributed to poorer diet quality, some argue that this ignores the effects of processing on the physical and chemical structure of a food, also called the food matrix. These changes to the food matrix may impact nutrient availability, digestion and absorption, though this remains an ongoing area of research.[12] For example, it has been hypothesized that highly processed sources of beta-glucan may be less effective at reducing serum cholesterol compared to less refined oat-based foods.[13] On the other hand, processing can also enhance the bioavailability of important food components involved in disease prevention, such as polyphenols.[12]

Processing that alters food structure may also influence eating behaviors. Reduced structural integrity can contribute to softer, more easily consumed foods that require less oral processing and may be less satiating per bite.[12] Softer textured foods have been linked to faster rates of eating and overconsumption in short-term randomized controlled trials.[14,15] Additionally, a small randomized controlled trial demonstrated that a two-week diet of UPF meals increased ad libitum energy intake compared to unprocessed meals that were matched for calorie, macronutrient, sugar, sodium and fiber content.[16] This difference was partially explained by a faster meal eating rate and higher energy density of the foods in the UPF group. A recent systematic review also suggests that UPFs may impair appetite regulation and stimulate reward related pathways in the brain, potentially leading to reduced satiety and increased food intake.[17]

Other concerns related to UPFs and their impact on adverse health outcomes stem from components introduced during processing, including additives, byproducts and packaging materials. Food additives such as artificial sweeteners, emulsifiers and preservatives are commonly used to enhance flavor, texture and shelf life, but the long-term health impacts of some additives remain under scientific investigation.[5] Byproducts formed during high-temperature processing, such as acrylamide and advanced glycation end products (AGEs), have been linked to oxidative stress and inflammation, though strategies are implemented to mitigate their production and human evidence remains limited.[18] Additionally, while not unique to food, packaging can introduce chemical contaminants like bisphenols and phthalates.[5] While causality has not been established and isolating the effects of these compounds from the overall diet remains challenging, these factors continue to be a subject of ongoing research.

Conclusion

Current evidence shows that diets high in UPFs are associated with a higher risk of obesity, Type 2 diabetes, cardiovascular disease and overall mortality. These diets have also been associated with a high intake of added sugars, saturated fats and sodium — nutrients shown to contribute to these chronic diseases when consumed in excess. However, the mechanisms by which UPFs may influence health outside of these dietary patterns or nutrients are less clear and likely involve a complex interplay of the food matrix, additives and displacement of whole foods.

Despite these concerns, many UPFs are convenient, affordable and widely available. Avoiding UPFs completely is often neither realistic nor necessary. Nutrition guidance should prioritize equity and practicality while promoting meaningful, sustainable improvements in diet quality. Evidence supports reducing the intake of UPFs high in added sugars, sodium and saturated fat and increasing intake of nutrient-dense foods such as vegetables, fruits, whole grains and lean proteins. In addition, addressing eating behaviors, such as rate of food consumption and satiety regulation, may offer a more comprehensive path to improving diet-related health outcomes. Continued research is needed to clarify the health effects of subgroups of UPFs and to identify the qualities of UPFs that predict adverse health outcomes.

Note from the Academy of Nutrition and Dietetics:

This summary reflects findings from evidence-based research and is a high-level overview of ultra-processed foods; this summary is not a comprehensive deep-dive on the topic. The information shared in this summary is up to date as of June 2025.

References

1. Dicken, S. J., & Batterham, R. L. (2021). 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,* 14(1), 23.
2. Hess, J. M., Comeau, M. E., Casperson, S., Slavin, J. L., Johnson, G. H., Messina, M., ... & Palmer, D. G. (2023). Dietary guidelines meet NOVA: developing a menu for a healthy dietary pattern using ultra-processed foods. *The Journal of nutrition,* 153(8), 2472-2481.
3. Aljahdali, A. A., Rossato, S. L., & Baylin, A. (2024). Ultra-processed foods consumption among a USA representative sample of middleolder adults: a cross-sectional analysis. *British Journal of Nutrition*, 131(8), 1461-1472.
4. Weaver, C. M., Dwyer, J., Fulgoni III, V. L., King, J. C., Leveille, G. A., MacDonald, R. S., ... & Schnakenberg, D. (2014). Processed foods: contributions to nutrition. *The American journal of clinical nutrition*, 99(6), 1525-1542.
5. Lane, M. M., Gamage, E., Du, S., Ashtree, D. N., McGuinness, A. J., Gauci, S., ... & Marx, W. (2024). Ultra-processed food exposure and adverse health outcomes: umbrella review of epidemiological meta-analyses. *BMJ*, 384.
6. Barbaresko, J., Broeder, J., Conrad, J., Szczerba, E., Lang, A., & Schlesinger, S. (2025). Ultra-processed food consumption and human health: an umbrella review of systematic reviews with meta-analyses. *Critical reviews in food science and nutrition*, 65(11), 1999-2007.
7. Liang, S., Zhou, Y., Zhang, Q., Yu, S., & Wu, S. (2025). Ultra-processed foods and risk of all-cause mortality: an updated systematic review and dose-response meta-analysis of prospective cohort studies. *Systematic reviews*, 14(1), 53.
8. Martínez Steele, E., Popkin, B. M., Swinburn, B., & Monteiro, C. A. (2017). The share of ultra-processed foods and the overall nutritional quality of diets in the US: evidence from a nationally representative cross-sectional study. Population health metrics, 15, 1-11.
9. Bhave, V. M., Oladele, C. R., Ament, Z., Kijpaisalratana, N., Jones, A. C., Couch, C. A., & Kimberly, W. T. (2024). Associations between ultraprocessed food consumption and adverse brain health outcomes. *Neurology*, 102(11), e209432.
10. Fang, Z., Rossato, S. L., Hang, D., Khandpur, N., Wang, K., Lo, C. H.,... & Song, M. (2024). Association of ultra-processed food consumption with all cause and cause specific mortality: population based cohort study. *Bmj*, 385.
11. Kim, Y., Cho, Y., Kim, J. E., Lee, D. H., & Oh, H. (2025). Ultra-Processed Food Intake and Risk of Type 2 Diabetes Mellitus: A DoseResponse Meta-Analysis of Prospective Studies. *Diabetes & metabolism journal*, 10.4093/dmj.2024.0706. Advance online publication.
12. 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.
13. Grundy, M. M. L., Fardet, A., Tosh, S. M., Rich, G. T., & Wilde, P. J. (2018). Processing of oat: the impact on oat's cholesterol lowering effect. *Food & function*, 9(3), 1328-1343.
14. Teo, P. S., Lim, A. J., Goh, A. T., Janani, R., Choy, J. Y. M., 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.
15. Lasschuijt, M., Camps, G., Mars, M., Siebelink, E., De Graaf, K., & Bolhuis, D. (2023). Speed limits: the effects of industrial food processing and food texture on daily energy intake and eating behaviour in healthy adults. *European Journal of Nutrition*, 62(7), 2949-2962.
16. Hall, Kevin D., et al. "Ultra-processed diets cause excess calorie intake and weight gain: an inpatient randomized controlled trial of ad libitum food intake." *Cell metabolism* 30.1 (2019): 67-77.
17. Ulug, E., Pinar, A. A., & Yildiz, B. O. (2025). Impact of ultra-processed foods on hedonic and homeostatic appetite regulation: A systematic review. *Appetite*, 108139.
18. Xiong, K., Li, M. M., Chen, Y. Q., Hu, Y. M., & Jin, W. (2024). Formation and Reduction of Toxic Compounds Derived from the Maillard Reaction During the Thermal Processing of Different Food Matrices. *Journal of food protection*, 87(9), 100338.