LWW | August4,2025 2:25 PM | 4 Color Fig(s): F1, 2 | Art:CIR001365

Embargoed until 5:00 a.m. ET, Friday, Aug. 8, 2025.

Circulation

review-article

AHA SCIENCE ADVISORY

Ultraprocessed Foods and Their Association With Cardiometabolic Health: Evidence, Gaps, and Opportunities: A Science Advisory From the American Heart Association

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ABSTRACT: Ultraprocessed foods and beverages (UPFs) pose a growing public health challenge. Commonly defined by the Nova system, UPFs are industrially processed products made with additives or ingredients not commonly used in home cooking. Although ultraprocessing or extensive processing can lower cost and improve shelf life, convenience, and taste of certain products, high UPF intake is consistently linked to negative health outcomes. Although mechanisms remain unclear, evidence supports food policies that limit UPF intake while avoiding unintended consequences. Identifying high-risk UPF subgroups is essential to balancing nutritional goals with the need for accessible and appealing food options. Most UPFs overlap with foods high in saturated fat, added sugars, and sodium, which are already targets for cardiometabolic risk reduction. Future priorities include uncovering how UPFs specifically affect cardiometabolic health, refining dietary guidance to discourage nutrient-poor UPFs, and clarifying the impact of UPFs with more favorable profiles. This science advisory reviews current evidence on UPFs and their impact on cardiometabolic health and outlines research needs, regulatory reform, and policy changes needed to affect better dietary intake and overall health.

Key Words: AHA Scientific Statements ■ American Heart Association ■ cardiometabolic risk factors ■ dietary patterns ■ food, processed ■ food-processing industry ■ nutrition policy

Excess global consumption of ultraprocessed foods and beverages (UPFs) is a public health concern. Human diets are increasingly including more industrially processed foods, leading to various systems for classifying foods based on processing criteria. Among these, the Nova system is the most widely used and is the focus of this advisory.[1] The Nova classification system presents 4 food groups, defined according to the nature, extent, and purpose of industrial food processing applied. Notably, the categorization does not include a breakdown of the nutritional quality of the foods.

Observational studies consistently link higher UPF intake with increased risk of cardiometabolic disease, chronic illness, and mortality.[2] Consumption is highest in developed countries and is rising globally, with estimates varying by the assessment method.[3–13] UPF intake is also elevated among certain sociodemographic groups, reflecting broader health disparities.[14–16]

The relationship between UPFs and health is multifaceted. Most UPFs, particularly those that dominate US dietary patterns, can be easily identified by consumers as "junk" food. They are characterized by poor

An author previously employed by the National Institutes of Health participated in the development of this science advisory. Per Federal Executive Order, the author removed themself from the manuscript in February 2025 to allow publication without material changes in content. The remaining authors agreed to this change.

Supplemental Material is available at https://www.ahajournals.org/doi/suppl/10.1161/CIR.0000000000001365.

Circulation is available at www.ahajournals.org/journal/circ

CLINICAL STATEMENTS AND GUIDELINES

Lay Summary

Ultraprocessed foods (UPFs) are a new way to describe foods according to whether certain additives are used, distinct from traditional nutrients and natural ingredients. UPFs are a growing concern because of widespread consumption and potential impact on health risks. These foods often contain additives widely used in industrial food production and not commonly used in home cooking. It is estimated that >70% of grocery store items and more than half of the calories in the average US diet come from foods containing at least one of these.

Most of the foods containing industrial additives are also high in unhealthy fats, added sugars, and salt. Although the additives are part of the issue, the main problem is that children and adults in the United States eat excessive amounts of nutritionally poor UPFs. These include items like sugary drinks, processed meats, refined grains, candies, baked goods, and chips—commonly referred to as junk food. These foods have long been discouraged by US and American Heart Association dietary guidelines.

The advisory reinforces current dietary guidelines:

- Reduce the intake of most UPFs, especially junk foods, and
- Replace most UPFs with healthier options such as vegetables, fruits, whole grains, beans, nuts, seeds, healthy oils, and lean proteins.

However, not all UPFs are harmful. Certain whole grain breads, low-sugar yogurts, tomato sauces, and nut or bean-based spreads are of better diet quality, have been associated with improved health outcomes, and are affordable, allowing possible inclusion in diets. These food products should be monitored and reformulated if future data show harm to overall health.

The focus should be on cutting back the most harmful UPFs that are already high in unhealthy fats, added sugars, and salt while allowing a small number of select, affordable UPFs of better diet quality to be consumed as part of a healthy dietary pattern.

nutritional quality; typically are high in saturated fats, added sugars, and sodium (HFSS); and have excessive calories, which contribute to adverse health outcomes through multiple biological pathways. Emerging evidence also suggests that certain additives and industrial processing techniques may have negative health effects.[17–21] However, recent studies reveal heterogeneous associations between specific UPF subgroups and health outcomes, underscoring the need for further investigation.[22–25]

Although UPF-rich diets are strongly linked to adverse health outcomes,[2,26,27] developing nutrition guidance and policy based solely on the Nova classification remains challenging. The reason is that some nutrient-dense foods with UPF characteristics may be neutral or even beneficial to health.[2–25] In addition, criteria such as the use of additives for palatability are often subjective, further limiting consensus on a clear definition.[28–32] Despite progress in establishing operational markers or indicators of processing, the classification of UPFs remains rather complex.[33] Policy development is further constrained by limited mechanistic insight, debate about the health risks of all UPFs, and concerns about unintended consequences, especially in countries where UPFs dominate the food supply and support nutrition security.[22–24] A pragmatic, consensus-driven approach that identifies key research and policy gaps is essential for guiding effective, evidence-based food system reform.

Identifying which UPFs pose clear public health risks can help shape a policy-relevant definition for regulation. This science advisory aims to summarize current evidence, to highlight key knowledge gaps, and to establish research priorities to guide dietary recommendations and policy development.

DEFINING UPFs OF PUBLIC HEALTH CONCERN

Various food classification systems have been developed to categorize foods based on processing level and, in some cases, nutritional profile (Table 1). Most systems differentiate between highly and minimally processed foods by considering the extent of processing, the presence of additives, and, particularly in Nova-based models, the intended purpose of processing. Although the criteria vary across systems (Table 2), the Nova and Siga frameworks are among the most comprehensive. Notably, Siga further distinguishes UPFs by the number and type of additives used.

The Nova classification system categorizes foods into 4 groups, from unprocessed or minimally processed (Nova 1) to ultraprocessed (Nova 4), as outlined in Table 2. Notably, Nova does not account for nutritional quality in its classification. Its most recent iteration distinguishes UPFs from processed foods (Nova 3) with the use of operational markers.[1] UPFs are identified by the presence of food substances of no culinary use (or ingredients not used in home cooking) such as industrial food substances or cosmetic additives intended to enhance appearance, flavor, or texture.[1] Although earlier definitions emphasized extensive industrial processing

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Table 1. Food Processing Classification Systems

Name	Country	Year introduced	Categories	Definitions
National Institute of Public Health[34]	Mexico	2007	Nonindustrialized (not processed)	Locally made traditional and modern foods prepared outside the home
			Traditional industrialized	Foods that are part of traditional Mexican culture according to customs and traditions since before the 20th century and are produced industrially
			Modern industrialized	Foods that have been incorporated into the Mexican diet, either as single products or mixed with other ingredients, that are impossible to separate
International Agency for Research on Cancer[35,36]	Europe	2009	Nonprocessed	Foods consumed raw without any further processing or preparation except washing, cutting, squeezing
			Modestly or moderately processed (1 and 2)	1. Industrial and commercial foods involving relatively modest processing and consumed with no further cooking 2. Foods processed at home and prepared/cooked from raw or moderately processed foods
			Highly processed	Foods industrially prepared involving processes such as drying, flaking, hydrogenation, heat treatment, use of industrial ingredients, and industrial deep frying. Includes foods from bakeries and catering outlets requiring no or minimal domestic preparation apart from heating and cooking. Category subdivided into processed staple/basic foods and highly processed foods.
Nova[37,38]	Brazil	2009		Nova defines food groups according to the extent and purpose of industrial processes
			Unprocessed or minimally processed foods (group 1)	Group 1: Unprocessed refers to whole foods. Minimally processed refers to foods altered by processes such as removal of inedible or unwanted parts, drying, crushing, grinding, fractioning, roasting, boiling, pasteurization, refrigeration, freezing, placing in containers, vacuum packaging or nonalcoholic fermentation. These processes preserve foods, make them suitable for storage, facilitate their culinary preparation, enhance their nutritional profile, and make them easier to digest.
			Processed culinary ingredients (group 2)	Group 2: These are substances obtained directly from group 1 foods or from nature such as oils and fats, sugar, and salt. They are created by industrial processes such as pressing, centrifuging, refining, extracting, or mining, and their use is in the preparation, seasoning, and cooking of group 1 foods. They are highly durable but usually not consumed by themselves.
			Processed foods (group 3)	Group 3: These are products made by adding salt, sugar, or other substances found in group 2 to group 1 foods; using preservation methods such as canning and bottling; and, in the case of breads and cheeses, using nonalcoholic fermentation. Food processing here aims to increase the durability of group 1 foods and make them more enjoyable by modifying or enhancing their sensory qualities. These foods are ready to consume by themselves or in combinations.
			UPFs (group 4)	Group 4: These are industrially manufactured food products made up of several ingredients (formulations), including sugar, oils, fats, and salt (generally in combination and in higher amounts than in processed foods) and food substances of no culinary use (eg, high-fructose corn syrup, hydrogenated oils, modified starches, and protein isolates). Processes include industrial techniques such as extrusion, molding, and prefrying; application of additives, including those that function to make the final product palatable or hyperpalatable such as flavors, colorants, nonsugar sweeteners and emulsifiers; and sophisticated packaging, usually with synthetic materials.
International Food Policy Research Institute[39]	Guatemala	2011	Unprocessed	Undefined
			Partially (primary) processed	Undefined
			Highly processed	Foods that have undergone secondary processing into readily edible form, likely to contain high levels of added sugars, fats, or salt
International Food Information Council[40]	United States	2012	Minimally processed	Foods that retain most of their inherent properties
			Processed for preservation	Processing to maintain freshness (shelf life)
			Mixtures, combined ingredients	Foods containing sweeteners, spices, oils, colors, flavors, and preservatives used to promote safety, taste, and visual appeal
			Packaged ready-to-eat foods	Packaged ready-to-eat foods and mixtures, possibly store prepared, containing high amounts of total and added sugars and low amounts of dietary fiber
			Mixtures, possibly store prepared	Foods packaged for ease of preparation (eg, frozen dinners, entrées, and prepared deli foods)

(*Continued*)

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Table 1. Continued

Name	Country	Year introduced	Categories	Definitions
Food Standards	Australia, New Zealand	2014	Unprocessed	Unmodified or have undergone processing limited to dividing, parting, severing, boning, mincing, skinning, paring, peeling, grinding, cutting, cleaning, trimming, deep freezing or freezing, milling or husking, packing, or unpacking[41]
			Processed	Food that has undergone any treatment resulting in a substantial change in the original state of the food
University of North Carolina[42]	United States	2015	Unprocessed	Single-ingredient foods and beverages that have undergone no or very slight modifications that do not change the inherent properties of the food as found in its raw or natural unprocessed form. Includes cleaning, portioning, packaging, removal of inedible fractions, fat reduction, drying, chilling, freezing, or pasteurization.
			Basic processed	Foods and beverages that have been processed but remain as single foods. Includes extraction, pressing, clarification, refining, purification, and milling. Preservation methods such as canning and milling of grain to remove germ to reduce spoilage.
			Moderately processed	Single minimally or basic processed foods but with the addition of flavor additives (sweeteners, salt, flavors, or fats) for the purpose of enhancing flavor; directly recognizable as their original plant or animal sources
			Highly processed	Foods and beverages are multi-ingredient industrially formulated mixtures processed to the extent that they are not recognizable as their original plant or animal source.
Siga[43]	France	2018	Unprocessed/ minimally processed (A)	A0: Intact raw initial matrix A1: Degraded raw matrix A2: Culinary ingredients used at home
			Processed (B)	Products made from A0 or A1, or both, with A2 ingredients B1: With added salt, sugars, fat within official recommendations B2: With added salt, sugars, fat above official recommendations
			Ultraprocessed (C)	C1: Loss of matrix effect with or without added unprocessed industrial ingredients, limited number of additives, or both C2: Loss of matrix effect with or without added processed industrial ingredients, a high number of additives, or both C3: Loss of matrix effect with or without added ultraprocessed industrial ingredients, a very high number of additives, or both
Additional definitions to consider, including USDA and the DGAC[44]			Processed	Any food other than a raw agricultural commodity, including any raw agricultural commodity that has been subject to washing, cleaning, milling, cutting, chopping, heating, pasteurizing, blanching, cooking, canning, freezing, curing, dehydrating, mixing, packaging, or other procedures that alter the food from its natural state. Processing also may include the addition of other ingredients to the food such as preservatives, flavors, nutrients, and other food additives or substances approved for use in food products such as salt, sugars, and fats. Processing of foods, including the addition of ingredients, may reduce, increase, or leave unaffected the nutritional characteristics of raw agricultural commodities.

DGAC indicates Dietary Guidelines for Americans Committee; UPF, ultraprocessed food and beverage; and USDA, US Department of Agriculture.
For more sources and their attempts, see https://www.cerealsgrains.org/publications/plexus/cfw/pastissues/2017/Documents/CFW-62-3-0120.pdf.[45]

and multi-ingredient formulations, these characteristics are no longer central to the operational definition of Nova.[38]

Because most UPFs are HFSS foods, low in fiber and recommended nutrients, limiting their intake appears justified.[27] However, a small number of UPF products such as certain commercial whole-grain, low-fat dairy, and some plant-based items may contribute positively to healthy dietary patterns.[46,47] This underscores the need for more nuanced subcategorization and mechanistic understanding rather than blanket recommendations to restrict all UPFs.[22,48,49] The lack of consensus continues to impede research and policy development. Establishing agreement could advance our understanding of how different UPF subgroups and degrees of processing, such as the type of additives, affect health.[50]

A major challenge in defining UPFs for policy use is ensuring that the 2023 operational criteria[1] can be applied consistently without subjective interpretation (Figure 1,[27,51,52] Table 3, and Supplemental Tables 1a and 1b).[52a,53] This requires improved dietary assessment tools and more detailed food composition databases.[54] For instance, many additives serve multiple functions; sodium citrate, for example, falls under 5 Codex-defined categories, 2 of which are cosmetic.[55–57] Similarly, sodium nitrite acts as both a preservative and a color agent. Although preservatives alone do not classify a food as a UPF, some also function as cosmetic additives, thereby complicating classification.[38] In addition, industrial processing

Table 2. Comparison Between Processing Systems Across Different Dimensions

	National Institute of Public Health, Mexico	International Agency for Research on Cancer	Nova	Food Policy Research Institute	International Food Information Council	Food Standards, Australia	University of North Carolina	Siga
Addition of nutrients			✓	✓	✓	✓	✓	✓
Consideration of food culture, tradition	✓		✓					✓
Matrix destruction			✓					✓
Mode of consumption			✓				✓	✓
Processing techniques used		✓	✓			✓	✓	✓
Branding and marketing			✓					✓
Purpose and intent of processing			✓		✓		✓	✓
Presence of additives			✓		✓	✓	✓	✓
Presence of food substances of no culinary use/exclusive industrial use			✓					✓
Attempt to differentiate between number of additives								✓
Attempt to differentiate between type of additives			✓					✓
Place of preparation/ manufacture	✓	✓	✓				✓	✓
Scale of manufacturing	✓	✓	✓				✓	✓
Examples of food	✓	✓	✓	✓	✓	✓	✓	✓

methods that alter food structure and nutrient bioavailability are not included in the definition because they are not unique to UPFs and are not disclosed on labels (Supplemental Table 1c). Thus, although all UPFs are industrially processed, not all processed foods meet the UPF criteria.

Benefits and Risks of Food Processing and Ultraprocessing

Benefits

Not all industrially processed foods are classified as UPFs. Certain processing methods offer clear benefits, including improved food safety; extended shelf life; reduced costs; and preservation of nutritional, functional, and sensory qualities.[53,58–60] Some techniques also enhance year-round food availability and convenience and may even reduce harmful compound formation.[30,61] Additional advantages include the use of antioxidants to prevent spoilage and nutrient fortification such as folic acid to address dietary inadequacies (eg, folic acid fortification to prevent neural tube defects).

Processing can enhance convenience, and in the context of time constraints and reduced home cooking, moderate use of a small number of nutrient-dense UPFs may support healthier dietary patterns.[62] This can also reduce the domestic labor burden—historically shouldered by women—aligning with the United Nations Sustainable Development Goal of promoting sex equity.[63,64] Moreover, modest use of such foods may help offset other costs associated with adopting healthier diets.[53,65]

Risks

Certain ingredients, additives, and processing methods used in UPFs may pose long-term health risks through both direct and indirect mechanisms.[38,66,67] Evaluating these risks independently of nutritional quality is challenging because high-UPF diets are typically low in overall diet quality and high-quality diets that are also UPF rich are rare.[68–70] Nevertheless, associations between UPF intake and cardiometabolic outcomes persist even after adjustment for diet quality and nutrient composition, highlighting the need for more precise mechanistic research.[17–21] Notably, a randomized crossover trial controlling for macronutrients, salt, sugar, and fiber found that diets higher in UPFs led to significantly greater ad libitum energy intake.[71]

Indirect Effects: Food Environment–Level Mechanisms That Promote Less Favorable Dietary Patterns

Similar to the global nutrition transition, the rapid rise in UPF consumption since the 1990s[72–75] has disrupted traditional dietary patterns, potentially contributing to adverse health effects. Because of their affordability, convenience, variety, and aggressive marketing, particularly toward youth and communities of color, UPFs often displace healthier alternatives.[76] This shift promotes dietary patterns that are lower in nutritional quality and misaligned with American Heart Association recommendations.[27,77,78]

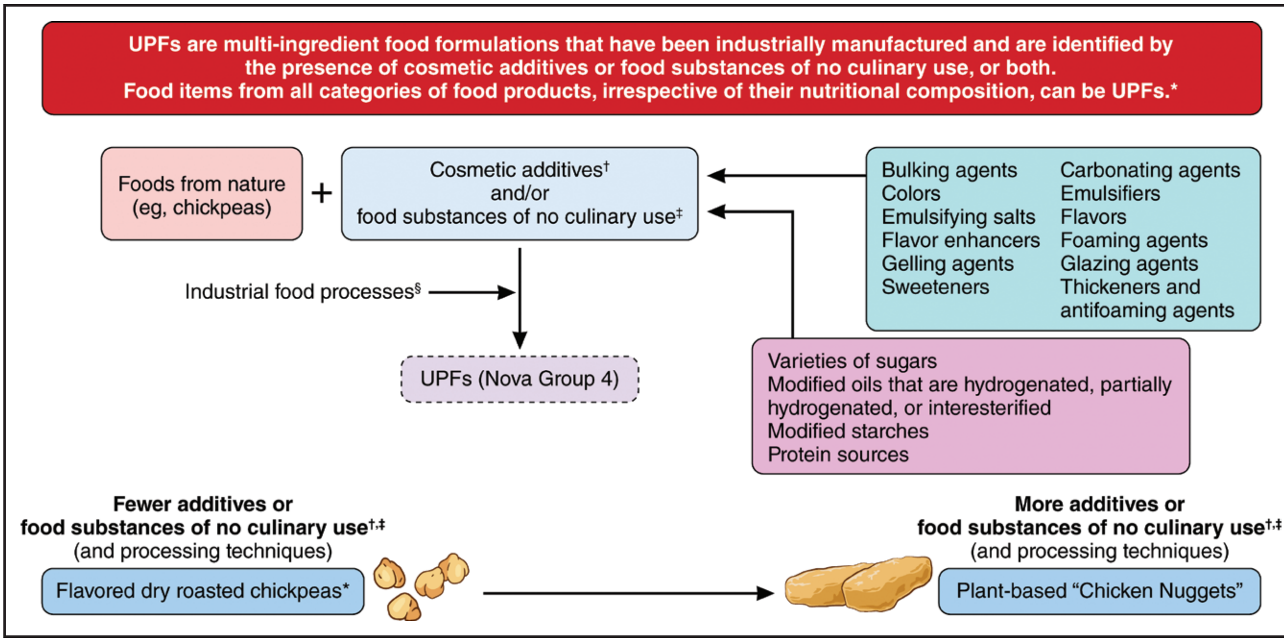

Figure 1. What are UPFs, and where are they found?
Figure 1 operationally defines UPFs based on the Nova criteria to facilitate identification and to demonstrate their nutritional heterogeneity. *The Nova classification system is used to define UPFs. Operationally, UPFs are distinguished from processed foods by containing at least 1 cosmetic additive or food substance of rare or no culinary use. All operationally defined UPFs undergo industrial processing, but not all foods that undergo industrial processing are UPFs. UPFs may contain few or many additives or food substances of no culinary use. In this example, the flavored dry-roasted chickpeas are considered a UPF because of a single additive (eg, natural flavors). Other foods such as jam may contain a single gelling agent/thickener such as pectin (additive) or maltodextrin (food substance of no culinary use). Many UPFs have multiple additives. In this example, plant-based nuggets contain methyl cellulose and lecithin (emulsifiers), as well as diphosphates (thickeners). †Classes of cosmetic additives include (1) bulking agents, (2) carbonating agents, (3) colors, (4) emulsifiers, (5) emulsifying salts, (6) flavors, (7) flavor enhancers, (8) foaming agents, (9) gelling agents, (10) glazing agents, (11) sweeteners, and (12) thickeners and antifoaming agents. ‡Classes of food substances of no culinary use (eg, nonadditive ingredients) include (1) varieties of sugars (eg, fructose, high-fructose corn syrup, "fruit juice concentrates," invert sugar, maltodextrin, dextrose, lactose, and other added sugars of rare culinary use), (2) modified oils that are hydrogenated or interesterified, (3) modified starches, and (4) protein sources (eg, hydrolyzed proteins, soy protein isolate, gluten, casein, whey protein, and "mechanically separated meat"). §UPFs also undergo sequential industrial physical or chemical processing (eg, extrusion, molding, prefrying, fractioning, grinding, hydrolysis, hydrogenation, or chemical modifications), exposure to packaging and neoformed contaminants, and marketing.

Direct Effects

Hypothetical Mechanisms Affecting Ingestive Behavior and Obesity

Industrial processing often disrupts the food matrix and cellular structure, particularly when fiber is removed, resulting in refined ingredients that are rapidly absorbed in the proximal gastrointestinal tract.[79] This can lead to exaggerated postprandial glucose and insulin responses, followed by transient hypoglycemia, which may stimulate hunger.[80] These alterations in gut signaling may impair appetite regulation.[81,82]

UPFs may promote obesity by increasing ad libitum energy intake through several mechanisms. Their high-energy density—often due to low fiber and water content—extends shelf life but also encourages overconsumption.[83–86] In addition, UPFs frequently contain hyperpalatable combinations of nutrients and textures that accelerate eating rate and enhance reward, further promoting excess intake and weight gain.[22,87–89] A secondary analysis of a randomized controlled trial confirmed that energy density, eating rate, and hyperpalatability were all positively associated with increased energy intake.[71,90]

UPFs also contain combinations of ingredients and additives that are uncommon in whole foods that enhance palatability and reduce cost.[87,90] These may influence reward-related brain activity,[91–96] potentially disrupting evolved nutrient-flavor associations. For example, artificial flavors may mimic sweetness without sugar or umami without protein, and the disruption in flavor-nutrient relationships has potential for dysregulated food intake and weight gain.[97,98]

Appetite-Independent Potential Mechanisms

Although exceptions exist, most UPFs consist of HFSS foods such as refined grains, sugar-sweetened foods and beverages, and processed meats.[99] Although a minority of UPFs are considered to be of better dietary quality, the majority are not.[100] This imbalance likely contributes to their adverse health effects.[101]

In addition, UPFs often contain additives that may negatively affect enteroendocrine cells and the gut microbiota.[102] A recent double-blind controlled feeding study

Table 3. Operational Markers and Processing Attributes of UPFs

Operational markers to identify UPFs	
Additives with cosmetic function	Food substances of no culinary use
Bulking agents Carbonating agents Colors Emulsifiers Emulsifying salts Flavors Flavor enhancers Foaming agents Gelling agents Glazing agents Sweeteners Thickeners and antifoaming agents	Varieties of sugars (eg, fructose, high-fructose corn syrup, "fruit juice concentrates," invert sugar, maltodextrin, dextrose and lactose, and other added sugars of no culinary use) Modified oils that are hydrogenated, partially hydrogenated, or interesterified Modified starches Protein sources such as hydrolyzed proteins, soya protein isolate, gluten, casein, whey protein, and "mechanically separated meat"
Common, nonoperational processing attributes of ultraprocessing	
Industrial physical or chemical processing often applied sequentially Extrusion Molding Prefrying Hydrogenation Fractioning Hydrolysis Grinding Chemical modifications	

UPF indicates ultraprocessed food and beverage.

found that a common emulsifier altered both the microbiome and metabolome compared with an emulsifier-free diet.[103] Certain processing methods such as high-heat treatment generate harmful compounds like advanced glycation end products, acrylamide, and heterocyclic amines.[104] Packaging materials may also introduce contaminants such as bisphenols, phthalates, and microplastics, which are linked to obesity, inflammation, and vascular complications.[75,105–108] US data show that higher UPF intake correlates with increased urinary levels of these contaminants and other neoformed compounds (Table 4).[109,110]

Trends in Existing Evidence of UPFs and Cardiometabolic Health

UPF Intake and Cardiometabolic Health Outcomes

Epidemiological studies consistently associate high UPF intake with increased risk of cardiometabolic disease. A meta-analysis of prospective studies found a dose-response relationship between UPF consumption and cardiovascular events, type 2 diabetes, obesity, and all-cause mortality.[22,88,89] An umbrella review classified these associations as convincing for cardiovascular mortality, highly suggestive for diabetes and obesity, and suggestive for cardiovascular morbidity.[2] High versus low UPF intake was linked to a 25% to 58% higher risk of cardiometabolic outcomes and a 21% to 66% higher risk of mortality.

Although overall UPF intake is consistently associated with harm, some nutrient-dense UPFs have shown neutral or even protective associations.[22–25,48] Further research is needed to differentiate UPF subgroups and to assess how factors such as geography, additives, processing techniques, and population characteristics influence health outcomes (Table 5).

Table 4. Mechanisms That May Contribute to Adverse Health Effects of UPFs

Displacement of healthier foods
Excess calories and foods and nutrients of public health concern
Ingredient formulations with potentially addictive properties
Textural changes that promote excess energy intake
Glucose/insulin axis disruption
Gut microbiota disruption
Exposure to toxins via additives, food packaging, or byproducts of processing

UPF indicates ultraprocessed food and beverage. The table describes the most plausible nutrient-based and non–nutrient–based mechanisms that may link UPFs to adverse cardiometabolic outcomes.

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Table 5. Strength of the Evidence and Research, Implementation, and Policy Priorities for UPFs*

Research areas	Summary	Future directions
Convincing evidence		
Overall UPF intake and higher cardiometabolic risk and mortality	Global evidence from epidemiological studies in adults and children is strong and consistent.	What are the effects of UPFs on cardiovascular health beyond the effects of traditional nutrients of concern (ie, HFSS)? (ie, what is the relative contribution or effect size of nutrient-based and non–nutrient-based mechanisms to the adverse health effects of UPFs), including the role of UPFs in promoting excess energy consumption and weight gain? Is the "permissible level" or threshold for consumption of UPFs (10%–15% of kcal or ≤2 servings/d)[111–113] for the maintenance of cardiometabolic health consistent for better and worse nutritional profile UPFs and consistent in prospective cohort studies? How do the metabolic and metabolomic responses of category-matched UPFs vs non-UPFs of varying nutritional profile compare? Are UPFs associated with secondary cardiovascular disease in high-risk populations? Are associations of UPFs and cardiovascular outcomes similar in racially and ethnically diverse study populations?
Probable evidence		
Inadequate safety of food processes and additives	Many countries and some states are banning the use of some additives based on documented adverse health effects.	Clinical studies evaluating the effects of matrix degradation on health outcomes Re-evaluation of food additives currently GRAS Mandatory disclosure standards for food manufacturers on food additives and amounts Clinical and epidemiological investigation of associations among food additives, food processes, and health markers
Mechanistic understanding of how UPFs influence cardiometabolic risk and mortality	Emerging research demonstrates that the effects of UPFs extend beyond nutritional profile and include appetite and gut microbiota dysregulation.	To what extent does each dimension of UPFs (eg, cosmetic additives, food substances of no culinary use, nutritional profile, processing techniques) independently influence health outcomes? Clinical studies evaluating potential mediating mechanisms underlying the adverse effects of UPF on health, including addictive mechanisms
Limited, suggestive evidence		
Adverse effect of UPFs in the food system on environmental sustainability	There is limited evidence of dimensions of sustainability, and existing evidence has been shown in limited contexts.	Examine the impact of overall and plant-based UPFs on greenhouse gas emissions and other measures of environmental impact Examine the impact of reducing the degree of processing of high nutritional profile UPFs on palatability, perishability, food cost, and food waste Examine the impact of UPF additives on resilience of the food supply to global climate change

Implementation and policy considerations that affect intake of UPF subgroups of higher nutritional profile and cardiometabolic risk and mortality	Some epidemiological studies show null or inverse associations with UPF subgroups of higher nutritional profile; concerns have been noted about confounding and unclear contribution of specific additives and food processes to health risk.	Research Gaps:
		Do all UPF subgroups pose a concern for cardiovascular health? Which UPF subgroups pose the greatest concern for cardiovascular health? Are any UPF subgroups associated with good cardiovascular health (eg, whole grains)?
		Substitution analyses to better understand UPF subgroup effects and to help with targeting some UPFs over others/dietary recommendations/prioritizing public health efforts
		Joint modeling of associations between UPF and nutritional profile (eg, Nova+Nutriscore[51,52,114]) on health outcomes
		Implementation and Policy Considerations:
		Enhanced measurement and operationalization of UPFs (ie, developing policy-ready definitions of UPFs that include both degree of processing and nutritional components)
		  Inclusion of nutrient profile systems
		  Inclusion of food additives and food substances of no culinary use
		  Inclusion of food processes (ie, matrix deconstruction)
		  Inclusion of degree of processing with continuous vs binary scales
		Effectiveness evaluation of taxes on foods high in salt, added sugar, and saturated fat on reducing consumption and improving cardiovascular health
		Epidemiological evaluation of the effects of removing additives that are concerning for cardiovascular health from the food supply (ie, does removing certain additives from UPFs attenuate the adverse effects of UPFs on health?)
		Comprehensive SWOT analysis when developing policy guidance affecting UPFs of higher nutritional profile that may promote nutrition security and improve health equity

(*Continued*)

Table 5. Continued

Research areas	Summary	Future directions
Challenges replacing UPFs in government safety net programs; possible unintended consequences of defining UPFs in DGA and implementing in national programs[115,116]	Some have noted that government safety net programs like National School Lunch Program, Supplemental Nutrition Assistance Program, and Women, Infants and Children would be challenged to replace ready-to-heat or ready-to-eat items considered UPFs with nutritionally comparable but less processed versions from scratch.	Modeling implications for food cost, staffing needs, equipment needs, and food waste using implementation science frameworks, life cycle analysis, or systems analysis
Contribution of UPFs to food safety issues and food/nutrition security[115,116]	Generally, UPFs are lower cost and have longer shelf-life, less food spoilage, and therefore less waste. These characteristics also apply to many processed foods.	Effects on food and nutrient availability under ideal vs real-world scenarios of replacing UPFs and having fewer food choices once UPFs are eliminated or limited

DGA indicates Dietary Guidelines for Americans; GRAS, generally recognized as safe; HFSS, high in saturated fats, added sugars, and sodium; SWOT, strengths, weaknesses, opportunities, and threats; and UPF, ultraprocessed food and beverage.

*The categories of convincing, probable, and limited, suggestive evidence were subjectively determined by the writing group. Extensive discussion among the writing group on the relative strength of the evidence in each research area was conducted at the onset of drafting the scientific statement and with each review of the statement until consensus was reached.

Efforts to understand UPFs are hindered by limitations in dietary assessment tools and food composition databases, which often lack detailed information on additives and processing methods.[54] Most studies rely on food frequency questionnaires or 24-hour recalls, which do not capture brand-specific data or industrial ingredients. Moreover, US manufacturers are not required to disclose processing techniques or cosmetic additive quantities, limiting research and surveillance. These gaps contribute to variability in risk estimates.[117]

As the science evolves, food composition databases must be expanded to include nonnutrient components and structural characteristics of foods. Capturing changes to the food matrix relative to minimally processed counterparts will be essential for accurately assessing the health impacts of UPFs.[118]

Food Safety Regulation, Nutrition Security, and Global Sustainability

Closing Gaps

UPF consumption varies significantly across populations and is often higher in lower-income communities.[14] Promoting nutrition security—defined as stable access to affordable, nutritious foods that support health and prevent disease[119]—is essential to reducing diet-related chronic diseases.[120] This requires not only reducing HFSS UPF availability but also empowering consumers to make healthier choices and addressing the broader social, political, and economic systems that sustain current dietary patterns (Figure 2).[119,121]

For decades, research has shown that low-income communities, Black communities, and Hispanic communities often face limited access to large supermarkets offering diverse, affordable, and healthy foods, commonly referred to as food deserts.[122] In contrast, these communities are frequently saturated with small retailers (eg, convenience stores, dollar stores) and fast-food outlets that sell predominantly inexpensive, heavily marketed HFSS UPFs, creating so-called food swamps.[122–127]

Black consumers and Hispanic consumers are significantly more likely to be exposed to advertisements for HFSS UPFs within their communities.[128] These targeted marketing strategies often span multiple platforms, including television, social media, and gaming.[129] A 2022 Rudd Center report found that despite an overall decline in food advertising on television from 2017 to 2021, companies continued to disproportionately market HFSS UPFs to Black audiences and Hispanic audiences.[130]

A small number of UPF products such as whole-wheat breads and unsweetened soy milk with emulsifiers[68] can support nutrition security in low-income and low-access communities by offering convenient, affordable, and palatable options.[131] However, the strong evidence linking HFSS UPFs to increased cardiovascular risk underscores the need for targeted policy interventions to regulate their availability, marketing, and accessibility in disproportionately affected communities. Effective strategies include a mix of educational initiatives (eg, nutrition labeling and public awareness) and regulatory measures (eg, procurement standards, marketing restrictions, taxation, and subsidies for healthier alternatives).[132,133] These efforts must also ensure equitable access to nutritious, affordable, culturally appropriate foods to meaningfully advance nutrition security.[119,131,134]

Current US dietary patterns include a higher proportion of unhealthy foods (including "junk foods") across all levels of processing. For healthier dietary patterns, most food choices should come from foods in the green and yellow columns:

1. **Choose a lower proportion of ultraprocessed foods, by mostly including whole vegetables, fruits, nuts, seeds, legumes, whole grains, nontropical liquid plant oils, and low-fat dairy and fish, seafood, and, if meat or poultry is desired, choose lean cuts and unprocessed forms**
2. **Limit UPFs and non-UPFs that are HFSS. If choosing HFSS foods, choose less-processed versions**

	Least healthy foods (including junk foods) Less healthy nutritional composition Highly marketed, available, and *relatively* inexpensive and convenient	**Moderately healthy foods**	**Healthier foods** Healthier nutritional composition Limited marketing and availability, relatively expensive, and requires more cooking skill
Less processed	High-fat red meat, pork (eg, steak, ribs), butter, lard, beef tallow, tropical oils, 100% fruit juice, sour cream, sugar, honey, maple syrup Crackers, sweetened dried and canned fruit, brined vegetables Tortilla or potato-based chips (made with few ingredients and less processing) French fries	White rice and pastas, full fat plain milk, freshly made refined grain bread, salted nuts	Fresh or frozen fruits, vegetables without added sugars or salt, whole grains (eg, oats, brown rice), unsalted nuts, seeds, legumes, liquid plant oils, low-fat plain milk or yogurt, lean, unprocessed meat or poultry, fish and seafood, unsweetened beverages, and water; dried beans/legumes
More processed	Processed meat (eg, chicken nuggets, sausage, hot dogs), sugar-sweetened beverages (eg, sodas, energy drinks), cheese products (eg, liquid cheese products), cookies, candies, gummy fruit snacks, refined grain breads, rolls, tortillas (ie, "white" bread), dairy-based desserts (eg, ice cream), frozen and shelf stable ready-to-heat meals made with refined grains, high fats or processed meats (eg, pizza, instant noodles, boxed macaroni and cheese), some canned or instant soups, canned fruits in syrup, tortilla and potato-based chips (flavored and multi-ingredients)	Canned fruits in light syrup or 100% fruit juice, hard cheese (eg, cheddar), egg replacements, prepared/convenience meals made with food items from the Healthier Foods (green) column Low sodium/low fat canned soups Canned beans or legumes (with salt)	Lightly salted/flavored nuts, seeds, and legumes (eg, baked beans) Low-sodium canned beans/legumes; low sodium canned protein in water (eg, canned salmon, tuna, chicken) Unsweetened dried fruit–based snacks Low-sodium whole grain breads and crackers; lightly or unsweetened high fiber cereal Plant-based meat and dairy alternatives that are low in sodium, added sugars, and saturated fat (eg, soy milk, tofu)

Figure 2. How should we approach UPFs according to the evidence we have to date?
This figure describes foods that are aligned with the 2021 American Heart Association Dietary Guidance and existing evidence about the health risks of ultraprocessed foods and beverages (UPFs). This list is not exhaustive and is provided only to help guide understanding of the extent of processing and the nutritional value of ingredients or foods. The strongest and most consistent adverse effects of UPFs on cardiometabolic health are seen with UPFs with excess amounts of foods and nutrients of public health concern (eg, high in saturated fats, added sugars, and sodium [HFSS] foods such as processed meats, sugar-sweetened beverages, and refined grains). The framework presented holistically addresses the key tenets of the guidance by encouraging dietary patterns predominantly comprising minimally processed foods and processed foods instead of UPFs while prioritizing which UPFs are most important to limit and which UPFs may be carefully included. This practical, evidence-based approach is designed to support adherence to a heart-healthy pattern.

Regulation of Food Additives and Food Safety Oversight

The 1958 Food Additives Amendment established the US Food and Drug Administration's authority to regulate food additives.[135] However, it also allowed manufacturers to bypass premarket approval if substances were "generally recognized as safe," a list that began with 800 chemicals and now exceeds 10 000.[136,137] Despite safety concerns, limited resources, complex rulemaking, and industry-favorable loopholes have hindered timely reassessment.[137,138] Currently, ≈10 000 additives approved by the US Food and Drug Administration over the past 60 years or more remain unevaluated, and the cumulative effects of exposure to multiple additives are poorly understood.

Brominated vegetable oils, used since the 1920s, were only recently removed after a decade-long review prompted by international bans.[139] A similar process led to the removal of partially hydrogenated fats.[140] Given the impracticality of reassessing all additives, some states have enacted their own protections. In 2023, California banned 4 additives—brominated vegetable oils, potassium bromate, propylparaben, and red dye 3—effective in 2027.[66,141] New York is considering similar legislation.[142,143] These additives are already restricted in the European Union, United Kingdom, Canada, Australia, China, and Japan.[144]

Improved monitoring of both existing and emerging food additives presents a critical opportunity for innovation in food safety, waste reduction, and nutritional enhancement.[145–147] These efforts can also align with consumer preferences for taste, convenience, and health.[147] In the interim, precautionary reductions in additives of public health concern,[66,144,146,148–150] combined with machine-learning tools,[50] can help assess additive-related health risks and inform regulatory strategies.

Looking Ahead: The Importance of UPFs to Sustainable Environments and Food Systems

There is growing recognition of the importance of food systems in the context of a healthy planet[151] and preparing resilient global food systems to meet food needs.[147,152,153] Therefore, the implications of increased global UPF production and consumption warrant further attention.[12,43,111,154]

Many UPFs are derived from animal byproducts and heavily processed crops such as wheat, soy, corn, and oils linked to deforestation, ecosystem disruption, and pollution.[154] Although some plant-based UPFs (eg, meat and dairy alternatives) aim to support healthier, more sustainable diets, their net impact remains unclear.[65,111,155–157] For instance, Harvard cohort data suggest that adherence to the Planetary Health Diet, which includes some UPFs, is associated with improved health and global outcomes.[158]

With ≈90% of the world's caloric intake derived from just 15 crop species, UPF production may further reduce agrobiodiversity, disrupt traditional diets, and contribute to air contamination.[153,154] Developing standardized metrics that integrate food matrix, composition, and environmental impact will be essential for comprehensive UPF evaluation and reformulation.[159,160]

Developing Guidance for UPFs in the United States

Guidelines in the United States Compared With Other Countries

National discourse on UPFs in the United States is accelerating, with growing momentum for federal guidelines to formally define UPFs to inform policy and nutrition education, areas in which the United States currently lags behind other nations.[161] For example, the 2015 to 2020 Dietary Guidelines for Americans definition of processed meats contributed to New York City's policy to phase out processed meats (eg, deli meats, ham, bacon) from meals provided by city agencies, including schools, child-care centers, and public hospitals.[162] However, a 2023 review of federal and state policies from 1983 to 2022 found limited use of the term "highly processed," with only 1 Massachusetts school food policy explicitly referencing UPFs.[163]

Internationally, more than a dozen countries have incorporated explicit recommendations to limit or avoid UPFs in their national dietary guidelines.[53,164,165] Some municipalities such as Rio and Niterói in Brazil have excluded UPFs from school food programs,[166] and others such as Colombia have implemented taxes on UPFs.[167] In addition, the European Union and several countries—including the United Kingdom, Canada, Australia, New Zealand, China, and Japan—have banned the same 4 food additives recently prohibited in California.[66,144]

Implementing Nova-based UPF policies is more straightforward in countries where UPFs constitute a smaller proportion of the diet. In the United States, a phased regulatory approach may be more effective, initially distinguishing UPFs by nutritional quality and then targeting HFSS UPFs and specific cosmetic additives. This should be accompanied by ongoing surveillance and mechanistic research to evaluate health impacts (Supplemental Table 1d). Broad food system reform will require addressing key gaps in the UPF literature to inform policy, to drive industry reformulation, and to advance processing technologies, paralleling the national ban on industrial trans fats.[168]

Translation and Implementation Gaps

Developing a precise operational definition of UPFs for regulatory purposes, along with improving public understanding of UPF-related guidance and policy, is essential.[31,118,169] The current Nova classification includes products of varied nutritional profiles, highlighting the need for subcategorization using appropriate nutrient profiling systems[51,52,114,170]—a process that can potentially be enhanced by machine-learning applications[75]—as a foundational step for informing policy and systems-level translation. For instance, machine-learning tools such as FoodProX are beginning to quantify the degree of food processing and its association with health outcomes using a data-driven, rather than qualitative, framework.[50] Broader adoption of such tools holds significant potential to guide consumers, industry, and policymakers toward reducing overall dietary processing[171] in ways that align with healthful eating patterns, taste preferences, and sustainability goals. In the absence of detailed additive concentration data on food labels, these tools also offer

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a valuable means to assess the contribution of additives to health outcomes.

Historical precedent demonstrates that the absence of clear operational definitions can hinder efforts to modify federal nutrition programs.[172] Recent proposals for front-of-package labeling in the United States—targeting foods high in nutrients of public health concern, those containing nonnutritive sweeteners, or those classified as UPFs[173]—are likely to face translational challenges. Applying any of these criteria would result in a majority of the US food supply being labeled as items to limit, potentially complicating the implementation of federal nutrition assistance programs that currently depend on certain UPFs with relatively favorable nutritional profiles.[68,115]

Efforts to develop objective, operational definitions of UPFs are ongoing[170,174–176] and will be critical for improving policy translation. Notably, when warning label criteria are overly broad and lack interpretive nuance,[169] they risk diminishing label effectiveness through information overload, crowding-out effects, and consumer confusion.[177] Similarly, overreliance on the degree of processing as a proxy for healthfulness within the context of UPF-dominated and generally unhealthy US dietary patterns creates opportunities for the food industry to remove UPF markers from junk foods and promote them as better-for-you alternatives. More precise classification of UPF subgroups, initially through nutrient profiling systems and, over time, through mechanistic characterization linking UPF attributes to health outcomes, may accelerate the development of actionable, evidence-based policy.

Mechanistic Gaps

Further research is needed to clarify and elucidate the mechanisms underlying the associations between UPFs and health outcomes, enabling more precise classification and guidance. For example, a deeper understanding is required of how food marketing, food composition (including both nutritional and nonnutritional components such as texture, additives, nutrients, and energy density), and metabolic processes (eg, gastric emptying, gut microbiota) independently or synergistically contribute to these associations.[49,115] Targeted studies comparing metabolic and metabolomic responses to category-matched UPFs and non-UPFs with varying nutritional profiles could help uncover the role of nutritional “dark matter,”[178,179] or uncharacterized food components, in influencing microbiota composition, glycemic response, inflammation, and other physiological outcomes.[115,180]

If clinically meaningful differences are identified, systematic investigation into the specific attributes of UPFs responsible such as particular ingredients, additives, or industrial processing methods will be warranted. Establishing mechanisms and causality is essential to determine whether UPFs exert health effects distinct from those captured by conventional diet quality metrics.

Epidemiological Gaps

Key areas of inquiry related to UPFs that are most relevant to drive policy and product reformulation include (1) the health effects of UPF consumption across sociodemographic groups and life stages, including potential threshold effects; (2) the differential impact of UPF subgroups with better versus worse nutritional profiles; (3) the independent and combined effects of additives and processing techniques, apart from nutritional composition; and (4) improved methods for identifying UPFs in individual diets, particularly for research purposes.[181] UPF consumption varies significantly across demographic groups in the United States.[16,182,183] The long-term health implications of higher UPF exposure, especially during critical developmental periods, remain unclear, although some evidence shows that early exposure may reduce taste acceptance of healthier dietary patterns.[184–186] Evidence also suggests that health risks increase when UPFs exceed 10% to 15% of total energy intake, equivalent to ≈2 servings/d. These potential threshold effects warrant further investigation in prospective cohort studies.[111–113]

In addition, there is growing interest in whether HFSS UPFs[91,93] activate behavioral and biological pathways similar to those triggered by addictive substances such as nicotine. It is important to assess whether certain populations are particularly vulnerable to the reward-related properties of these foods.[187] Understanding whether adverse effects stem solely from nutritional composition or also from flavor additives and matrix degradation will enhance translational efforts. Continued improvements in dietary assessment tools and food composition databases will be essential to support this research.[54]

CONCLUSIONS

Most UPFs are HFSS, and excessive HFSS intake is inconsistent with American Heart Association dietary guidance. Although regulation of HFSS foods alone is warranted, growing evidence suggests that UPF-based dietary patterns may adversely affect cardiometabolic health through mechanisms beyond their HFSS content, underscoring the need for additional policy and systems-level interventions. Balancing multiple priorities, including the practical need for a nutrient-dense, affordable food supply, current evidence supports the following:

1. Introduction of multilevel approaches for individuals, food manufacturers, and the retail industry that promote a shift toward healthier dietary patterns by replacing most UPFs with vegetables, fruits, nuts, seeds, legumes, whole grains, nontropical liquid plant oils, fish, seafood, low-fat dairy, and, if desired, lean poultry and meats (Figure 2);
2. Enactment of multipronged policy and systems-change strategies (eg, front-of-package labels and

taxation) intended to reduce intake of HFSS products, many of which also meet operational UPF criteria (Supplemental Table 1e);

3. Increased research funding to identify mechanistic relationships between UPFs and cardiometabolic health to enhance the development of evidence-based policies enabled through comprehensive food composition databases, mandatory reporting and re-evaluation of the safety of food additives with plausible adverse health effects, and intelligent application of technologies, including machine learning to assess risks related to degree of processing; and
4. Enhancement of ongoing efforts to modernize the US Food and Drug Administration's food additive science,[137,148] including streamlined and efficient evaluation and regulation of food additives.[188]

The 4 substantive changes proposed in this science advisory are strong but nuanced, with the intent of catalyzing action by focusing attention toward areas where there is largely scientific agreement. Moreover, there is strength in mobilizing efforts when there is consensus, namely that action to address HFSS UPFs is needed and is an important starting point from which ongoing evaluation can be conducted. Uncertainty is not binary; the degree of certainty about the health harms of HFSS UPFs compels immediate action while balancing the uncertainties about some nutrient-dense foods with UPF additives. Underestimating uncertainty and forging ahead with unbridled momentum carry the risks of damaging scientific credibility and creating ineffective or even harmful policies that become formidable obstacles when emerging scientific evidence suggests that refinement is needed.

Food policy reform must consider the broader goals of the food system, including nutrition security, safety, and sustainability. Nonetheless, robust evidence and historical precedent support increased regulation of UPFs. Although transformation of the food system is complex, it is achievable. The expert consensus and road map outlined in this science advisory offer actionable steps to advance toward a food environment that is healthier, more sustainable, and accessible to all.

ARTICLE INFORMATION

The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

This advisory was approved by the American Heart Association Science Advisory and Coordinating Committee on February 25, 2025, and the American Heart Association Executive Committee on April 2, 2025. A copy of the document is available at https://professional.heart.org/statements by using either "Search for Guidelines & Statements" or the "Browse by Topic" area. To purchase additional reprints, call 215-356-2721 or email Meredith.Edelman@wolterskluwer.com

The American Heart Association requests that this document be cited as follows: Vadiveloo MK, Gardner CD, Bleich SN, Khandpur N, Lichtenstein AH, Otten JJ, Rebholz CM, Singleton CR, Vos MB, Wang S; on behalf of the American Heart Association Council on Lifestyle and Cardiometabolic Health; Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; Council on Genomic and Precision Medicine; and Stroke Council. Ultraprocessed foods and their association with cardiometabolic health: evidence, gaps, and opportunities: a science advisory from the American Heart Association. *Circulation.* 2025;152:e•••–e•••. doi: 10.1161/CIR.0000000000001365

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Disclosures

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Writing group member	Employment	Research grant	Other research support	Speakers' bureau/ honoraria	Expert witness	Ownership interest	Consultant/ advisory board	Other
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(*Continued*)

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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $5000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $5000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

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This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all reviewers are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $5000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $5000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

†Significant.

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