A policy approach to identifying food and beverage products that are ultra-processed and high in added salt, sugar and saturated fat in the United States: a cross-sectional analysis of packaged foods

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Summary

Background Governments globally aim to reduce the intake of unhealthy foods. Many policies exist that aim to address foods high in saturated fat, salt and sugar (HFSS) but the identification of ultra-processed foods (UPF) have presented a greater challenge due to the lack of an appropriate policy definition. To support policymakers, we provide approaches that can support governments to identify both HFSS foods and UPFs.

Methods Four approaches combining elements of UPF definitions (i.e., presence of additives) and HFSS definitions were compared attempting to simplify and standardize the identification of less healthy products. Nationally representative food purchase data from NielsenIQ linked with nutrition facts label data were used to examine the mean proportion of product volume purchased by US households to be targeted. Differences between approaches were examined using Student t test; Bonferroni adjusted P value < 0.0001 was considered significant.

Findings In 2020, 50% of 33,054,687 products purchased by US households were considered UPFs (65% of foods and 38% of beverages) and 43% HFSS (65% of foods and 26% of beverages), however there was not 100% agreement between the two definitions (P < 0.0001). By starting with HFSS criteria and adding elements of UPF (colors and flavors), we were able to provide a method with 100% agreement between the identification of UPFs and HFSS products.

Interpretation Results demonstrated how combining HFSS criteria with UPF criteria can be used to identify less healthy foods and ensure policymakers have both a simple and accurate method to target products for policy intervention.

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Keywords: Additives; Ultra-processed foods (UPF); Nonnutritive sweeteners (NNS); High in added saturated fat; Sodium; And sugar (HFSS)

Introduction

Over the last decade, concern related to the increased consumption of ultra-processed foods (UPFs) has grown across the globe.[1,2] UPFs are defined as ready-to-eat industrial products created from food-derived ingredients combined with food additives through various industrial processes and designed to maximize industry profits. Research has emerged over the last decade showing convincing evidence from all phases of research—be they a crossover randomized controlled trial[3] to longitudinal cohorts, to animal, metabolic, microbiome and neurological research - to show how consumption of these UPFs are detrimental to health.[4–17] Several attributes of UPFs explain their link with ill-health, including poor nutrient profiles (high in free sugars and unhealthy fats and low in protein and fiber), high

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Research in context

Evidence before this study

Research has emerged over the last decade showing convincing evidence from all phases of research—be they a crossover randomized controlled trial to longitudinal cohorts, to animal, metabolic, microbiome and neurological research– to show how consumption of UPFs is detrimental to health. Existing literature (via PubMed) was searched related to UPF consumption, HFSS consumption (particularly in the Americas), with studies limited to those published from January 1, 2014 to the present day. We found through our literature search that the NOVA classification system is the most widely used the literature to identify UPFs, and furthermore some countries now mention "UPFs" within their dietary guidelines. There is also now one country (Chile) that has written a HFSS definition into law in order to identify unhealthy products for policy intervention. Out of this we determined there is a need for a simple policy-ready definition of UPFs that considers not only the level of processing a product has but also its nutritional components.

Added value of this study

The US FDA is currently considering the implementation of a national front-of-pack labelling system. However, any definition of unhealthy foods that is to be used for policy needs to be simple for the food industry to implement. Current guidance on how to identify UPFs is difficult and subjective to implement, however research has demonstrated the importance of considering levels of processing when identifying less healthy foods. In contrast, identification of HFSS products is simpler, using information easily accessible on product nutrition labels. HFSS approaches however do not take into account the level of processing a product has gone through. This study outlined approaches (using solely information that is available on the packaging of processed foods and beverages) that could be considered by US policymakers to support consumers to make healthier food and beverage choices. We use a combination of elements under the HFSS and UPF definitions to identify an approach that addresses both the level of processing and whether a product is high in saturated fat, salt or sugar.

Implications of all the available evidence

A number of countries have now made food processing a major part of their dietary guidelines and alongside this, HFSS foods are increasingly becoming a target for policy intervention. This paper, which focuses on the US and its vast array of packaged food and beverage products, demonstrates how the combination of elements of the NOVA classification system to identify UPFs, and the now commonly used HFSS criteria to identify less healthy products, can help ensure that policymakers have both a simple and accurate method for the identification of less healthy food and beverage products.

energy density and hyper-palatability or quasi–addictive properties, and content of biologically harmful compounds.[18]

The NOVA food processing system is the most widely used approach to classify foods and beverages based on their extent and purpose of industrial processing; it is currently considered as the "gold standard" method to identify UPFs.[19–21] This system is focused on identifying products that are engineered, manufactured, and marketed to promote overconsumption. NOVA uses a broad food group-based approach and also considers markers of UPFs as coming from 12 classes of additives (flavour enhancers, colours, emulsifiers, emulsifying salts, sweeteners, thickeners, and anti-foaming, bulking, carbonating, foaming, gelling and glazing agents).[22,23] Food additives represent a useful indicator of how heavily processed a food might be[24] and it is these 12 additive classes which are thought to enhance hyper-palatability. However, NOVA has limitations for use in regulatory policies due to its subjective nature (regulatory policies need clearly verifiable and precise operational definition of food targets) and its focus solely on UPFs with no criteria for the levels of nutrients of concern.[25] By using the most common additives in one approach and then 12 Codex classes in a second, we show for the US food supply a policy option that can be used.

It is widely known that the modern food supply exposes populations around the globe to food and beverage products that are high in added saturated fat, added sodium and added sugar (HFSS), and that these foods are linked to a large number of chronic conditions. The Chilean Government was the first country to implement comprehensive policies to reduce the consumption of HFSS foods: in 2016, the Chilean Law of Food Labelling and Advertising imposed front-of-package warning labels, restricted marketing, and banned school sales of foods and drinks with high levels of added saturated fat, sodium, and sugar. However, policies to discourage unhealthy food purchases through HFSS approaches in the Americas such as those used by the WHO and the Chilean government nutrient profile model do not consider a product's level of processing such as what is done under the NOVA food processing system.

Recently there has been increased interest in combining approaches to help identify less healthy foods (such as HFSS) with those identifying UPFs (such as NOVA). Colombia was the first country in the world to create a law related to UPFs, in this case a tax on food that rises from 10% in November, 2023 to 20% in November 2025. However as there was not an adequate policy definition for UPFs, instead only HFSS foods and beverages were targeted. Understanding the extent to which the UPF and HFSS concepts overlap will be very useful in informing future policy design.

There is a need for a simple policy-ready definition of UPFs that considers not only the level of processing a product has but also its nutritional components. The aim of this study was therefore to develop a simple approach to support policymakers in the identification of both UPFs and HFSS products that should be targeted for policy intervention.

Methods

Study design and population

NielsenIQ is an ongoing nationally representative survey of US households that captures household purchases of more than 600,000 packaged barcoded food and beverage items. Participating households are given a barcode scanner for households to log barcodes for all purchases continuously throughout the year. Non-packaged food and beverages (those without barcodes) are not included (e.g., loose produce, meats sold by weight, bakery items, and prepared foods). Additional details on this NielsenIQ data can be found in earlier papers.[24,26] The current study utilized the 2020 panel. Household demographic characteristics are presented in Supplementary Table S1. Each uniquely barcoded product captured in 2020 was linked with Nutrition Facts Label (NFL) data and ingredient information using several commercial nutrition databases (Gladson, Label Insight, Product Launch Analytics, USDA National Nutrient Database for Standard Reference, and Mintel Global New Products Database) using barcodes and product descriptions as detailed in previous papers.[27,28] Based on NielsenIQ modules, products were assigned to 9 food categories (51 subcategories) or as a beverage (11 subcategories).

NOVA definition of UPFs

The literature describing how to determine UPFs using NOVA suggests broad food categories that are likely to be UPFs.[19–21] In addition, the same literature suggests that within these UPF groups, substances never or rarely used in kitchens as well as classes of additives designed to make the final product palatable are specific markers of UPFs. More detailed definitions of NOVA often specify the inclusion of 12 CODEX classes of additives. More recently in presentations, Monteiro (creator of NOVA) has suggested that the use of just colors and flavors might be a simpler way to delineate UPFs. To this effect, each of the 62 food/beverage subcategories were allocated to a NOVA "group" from 1 to 4 (1 = minimally processed foods, 2 = processed culinary ingredients, 3 = processed foods, 4 = UPFs). Products assigned NOVA group 4 were re-allocated to NOVA group 3 if the product did not include an ingredient among those specified under NOVA to identify UPFs (Supplementary Table S2 or the 12 CODEX classes of additives (Supplementary Table S3). A list of ingredient search terms for additives was compiled from the Food and Drug Administration (FDA) substances Added to Food inventory, previously known as Everything Added to Foods in the United States.

Classic HFSS criteria

The Chilean government nutrient profiling criteria were used to identify products that were HFSS[29–31] (Supplementary Table S4); the nutrients of concern included were calories, sugar, sodium, and saturated fat for any product that contained added sugar, sodium, and saturated fat. We selected Chile's nutrient profile criteria as our definition for "classic" HFSS because they are simple, are one of the oldest nutrient profiling systems for policies to reduce unhealthy foods, and are the criteria that multiple other countries have used for the basis of their policies to identify HFSS. For the purposes of this analysis, products containing added saturated fat, sodium, or sugar ingredients as well as exceeding the corresponding nutrient threshold were considered HFSS.

Comparative profiling approaches to identify food and beverage products to be targeted for policy intervention

Four alternative approaches combining elements of NOVA UPF and the classic HFSS criteria were compared as outlined below.

Approach #1: HFSS + non-nutritive sweetener (NNS) approach

Under Approach #1, products targeted for policy included those that were considered HFSS and also contained NNS. NNS were defined as substances listed as having both a NNS function under the Substances Added to Foods inventory and that also appear in the FDA's list of approved high-intensity sweeteners. Three additional additives (luo huan guo, sucralose and steviol glycosides) were also included in the definition of NNS as they appear in the FDA's list of approved high-intensity sweeteners but not under the Substances Added to Food inventory as NNS. To remain consistent with existing literature on NNS, sugar alcohols were also included as NNS (sorbitol, xylitol, lactitol, mannitol, erythritol, and maltitol).

Approach #2: HFSS + colors/flavors approach

Under Approach #2, products targeted for policy included those that were considered HFSS and also contained colors and/or flavors. Using the FDA's Substances Added to Food inventory, colors were defined as substances authorized by a regulation in 21 CFR Part 73, 74, or 82. Flavors were defined as substances with a Flavour and Extracts Manufacturers Association (FEMA) or Joint FAO/WHO Expert Committee on Food

Additives (JECFA) number, excluding those that are not listed as being a flavoring agent or flavor enhancer and excluding those in 182.10 category (herbs and spices).

Approach #3: HFSS + colors/flavors + NNS approach
Approach #3 combined approaches #1 and #2 with products targeted for policy if they were HFSS, contained NNS and/or contained colors and/or flavors.

Approach #4: HFSS + additives approach
Approach #4 built on Approach #3, with targeted products including those that were considered HFSS and contained flavors and/or one or more of the 12 CODEX classes of additives defined under NOVA (including color and/or NNS); Supplementary Table S3). The FDA combines two Codex categories of emulsifiers so only 11 are found in the supplement.

Statistical analysis
For each household, the proportion of barcoded products purchased classified as less healthy under each of the proposed policy approaches outlined above was calculated by dividing the volume of less healthy products purchased by the total volume of products purchased by that household. Volume refers to the value in grams or ml as provided on product packaging. Weighted means of the household proportions were then calculated utilizing household weights provided by NielsenIQ (projected to be nationally representative based on the following factors: household size, income, household head age, race-ethnicity, education, occupation, presence of children, and county size). Significant differences between the weighted mean proportions of the various approaches were examined using t-tests. Bonferroni multiple comparison adjustment was applied and a P value < 0.0001 was considered significant. Food groups containing no UPF products (all except NOVA group 4) were excluded from analyses. All analyses were performed using SAS v9.4. A flow chart presenting data used in analyses is reported in Supplementary Figure S1. By utilizing secondary de-identified NieslenIQ data, this work was exempted from institutional review board review. This study followed STROBE guidelines.[32]

Role of the funding source
The funders had no role in study design, data collection, data analysis, interpretation, writing of the report.

Results
Out of 33,054,687 products purchased by US households in 2020, 50% of purchases based on volume (utilizing NielsenIQ household projection weights) were considered UPFs (65% of foods and 38% of beverages; Table 1) and would therefore be targeted for policy intervention if the NOVA approach alone was used to identify less healthy food and beverage products for policy intervention. In contrast, 43% of product purchases were considered HFSS (65% of foods and 26% of beverages) and would therefore be targeted for intervention should the classic HFSS criteria be used. The proportion of product purchases that would be targeted for policy intervention under each of the four proposed alternative approaches ranged from 54% for Approach #1 (HFSS + NNS) to 73% for Approach #4 (HFSS + additives). The addition of NNS did not result in substantial differences in the proportion of product purchases that were considered HFSS between Approach #1 and Approach #2 (P = 0.99). Supplementary Table S5 provides percentage of purchases by each additive class separately.

Does NOVA encompass HFSS foods, and vice versa?
Fig. 1 shows the proportion of products that would be captured for policy intervention under NOVA, the HFSS criteria and each of the four approaches examined in this study for foods, beverages, and food and beverages combined. If NOVA alone was used to identify UPFs for policy intervention, it would miss 10% of HFSS products purchased by US households (16% of foods and 5% of beverages). Similarly, if the HFSS criteria alone were used for policy intervention it would miss 16% of overall UPFs (16% of foods and 17% of beverages). By starting with the HFSS criteria and adding elements of the NOVA definition for UPFs (colors/flavors ± NNS or additives), the "gap" in identification of UPFs and HFSS products went from 16% (HFSS) to 0% (Approach #4: HFSS + additives). Further detailed results on each proposed approach are as follows:

Approach #1 (HFSS + NNS)—Under Approach #1, 63% of food and beverage products purchased by US households would be targeted for policy intervention (41% overlap with NOVA), however Approach #1 "missed" 9% of products that would be classified as UPFs under NOVA. Approach #1 resulted in an extra 8% of products being captured for policy intervention compared to HFSS alone. This positive effect of adding NNS to HFSS criteria was made more obvious when examining beverages, with a 12% increase in the proportion of products captured compared to the HFSS criteria alone.

Approach #2 (HFSS + flavors/colors)—Under this approach, 67% of food and beverage products purchased by US households would be targeted for policy intervention (49% overlap with NOVA). The addition of flavors and colors to the HFSS criteria left only 1% of overall food and beverage product purchases considered UPFs that would be "missed" for policy intervention. For beverages, the gap was closed completely, with all NOVA UPF beverage products captured under Approach #2.

Approach #3 (HFSS + flavors/colors + NNS)—The addition of NNS under Approach #3 resulted in no change in the proportion of products that would be targeted for policy intervention compared to Approach

Category or subcategory	N. products purchased	NOVA % UPFs	% Classic HFSS	Approach #1	Approach #2	Approach #3	Approach #4
				% HFSS + NNS	% HFSS + colors/flavors	% HFSS + NNS + colors/flavors	% HFSS +12 Codex additives[c] classes
Food	26,971,821	65%	65%	67%[ab]	85%[abc]	85%[abc]	88%[abcde]
Dairy products excl milk	3,943,072	38%	65%	70%	83%	83%	88%
Meat, poultry, fish & mixtures	2,364,857	43%	64%	64%	74%	74%	77%
Grain products, no RTE desserts	5,216,829	65%	44%	46%	85%	85%	89%
RTE cereals and granola	781,335	88%	98%	99%	99%	99%	99%
Other grain products	4,435,494	61%	36%	37%	82%	83%	87%
Sauces & Condiments	2,094,037	67%	87%	87%	89%	89%	89%
Sweets & Snacks	9,305,511	71%	77%	79%	87%	88%	89%
RTE grain-based snacks	5,229,597	76%	77%	78%	95%	95%	96%
Spreads and toppings	604,344	52%	84%	85%	86%	86%	87%
Candy & Gum	1,893,571	81%	95%	98%	100%	100%	100%
Sweeteners	357,893	29%	26%	34%	30%	34%	34%
Puddings & Ice Cream	1,220,106	88%	90%	94%	96%	96%	99%
Mixed dishes and soups	4,047,515	81%	63%	63%	88%	88%	92%
Frozen entrees, appetizers and pizza	1,726,426	87%	62%	62%	92%	92%	97%
Other mixed dishes	2,321,089	76%	64%	65%	84%	84%	88%
Beverages	6,082,866	38%	26%[a]	42%[ab]	51%[abc]	51%[abc]	60%[abcde]
Dairy beverages	1,472,634	17%	5%	5%	22%	22%	24%
Fruit and vegetables juices	1,296,094	36%	36%	52%	68%	68%	80%
Carbonated soft drinks	1,661,476	90%	56%	88%	95%	95%	97%
Other beverages	1,652,662	5%	17%	26%	29%	29%	45%
Total	**33,054,687**	**50%**	**43%[a]**	**54%[ab]**	**66%[abc]**	**66%[abc]**	**73%[abcde]**

P < 0.0001 compared to [a]NOVA %UPF; [b]Classic HFSS; [c]Approach #1; [d]Approach#2; [e]Approach #3. For comparisons of foods, beverages, and food/beverages combined using SAS 9.4 survey procedures with domain analyses and NielsenIQ projection weights (Bonferonni corrected P values). [a]Proportion of purchases based on volume (g/ml specified on product packaging) and calculated utilizing projection weights provided by NielsenIQ which takes into account the following factors: household size, income, household head age, race-ethnicity, education, occupation, presence of children, and county size. [b]University of North Carolina calculations based in part on data reported by NielsenIQ through its Homescan Services for all food categories, including beverages and alcohol for 2020 across the U.S. market (NielsenIQ, 2021). The conclusions drawn from the data are those of UNC and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for and had no role in, and was not involved in, analyzing and preparing the results reported herein. [c]Additives includes NNS, colors/flavors and other additives (Anti-foaming agent, Foaming agent, Bulking agent, Gelling agent, Thickener, Carbonating agent, Emulsifier, Emulsifying salt, Flavour enhancer, Glazing agent).

Table 1: **Number and proportion[a] of less healthy products purchased by US households that would be targeted for policy intervention under each nutrient profiling approach, 2020 data (N households = 59,938).[b]**

#2. This suggests that most, if not all product purchases containing NNS also contained flavors and/or colors, and so the need to include the additional criteria for the presence of NNS would not be required if Approach #2 was used as a way to identify less healthy food and beverage products for policy intervention. This result was seen overall, in foods and in beverages.

Approach #4 (HFSS + additives)—Under Approach #4, 100% of product purchases considered UPFs under NOVA would be targeted for policy intervention, closing the "gap" between the HFSS criteria and NOVA. Under Approach #4, 73% of food and beverage products purchased overall by US households would be targeted for policy intervention (50% overlap with NOVA and 23% unique to this approach).

Discussion

This study outlined a series of approaches to support policymakers in the identification of both UPFs and HFSS products that should be targeted for policy intervention. We found that focusing solely on UPFs missed a large proportion of food purchases which would be considered HFSS (16% of food and 5% of beverage purchases). Similarly, we found that focusing solely on HFSS missed a large proportion of UPFs (16% of foods and 17% of beverage purchases). By combining elements of the NOVA definition of UPFs with HFSS criteria (using solely information that can be obtained from the product's Nutrition Facts Label and ingredients list), we presented a potential approach to support countries in identifying less healthy products that could be targeted for policy intervention.

Under each approach examined, the proportion of purchases considered that would be considered UPFs and/or HFSS and therefore be targeted for policy ranged from 60 to 73% overall (80–88% of foods and 43–60% of beverages). By starting with the classic HFSS criteria and adding elements of the NOVA definition for UPFs (NNS, colors/flavors and additives), the "gap" between

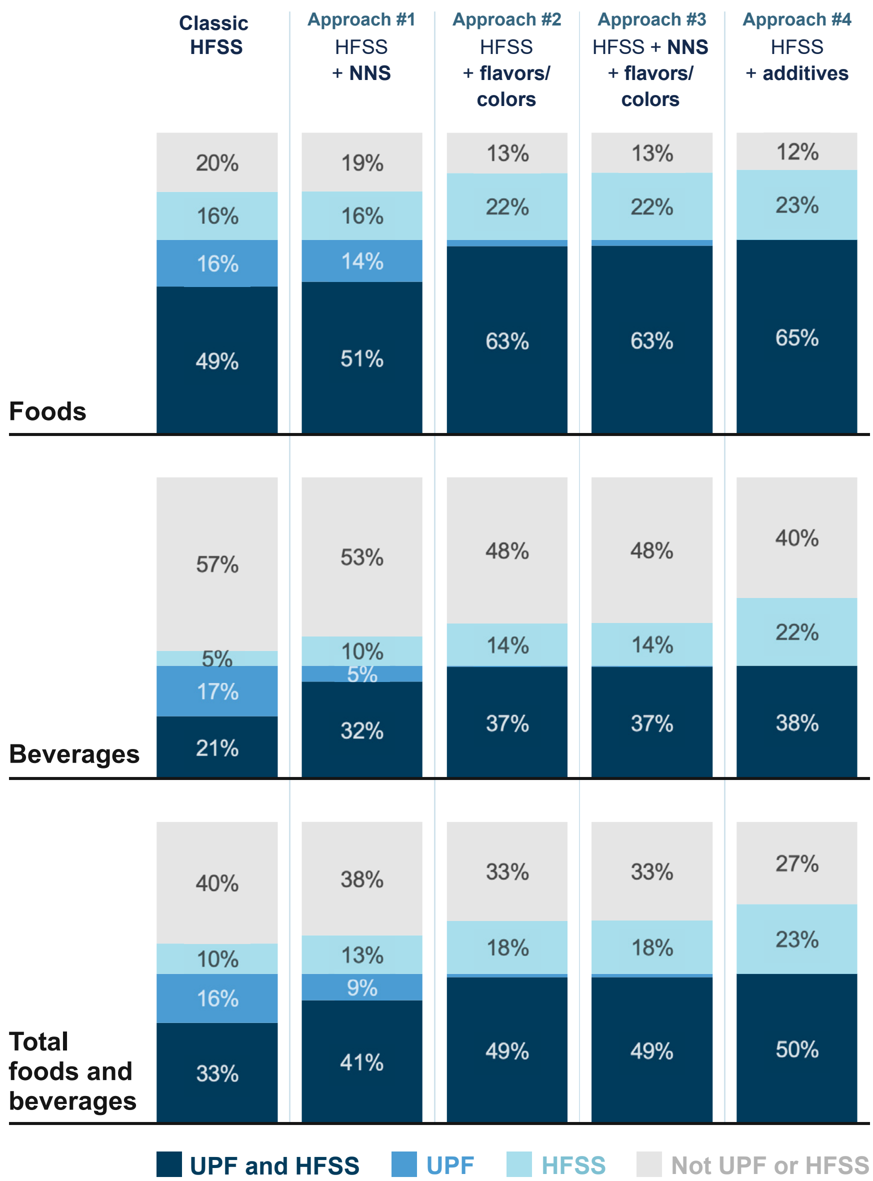

Fig. 1: **Proportion of products purchased by US households identified as UPF and HFSS under each nutrient profiling approach, 2020 data (N households = 59,938).** UPF, ultra-processed food based on NOVA classification HFSS, High in Saturated Fat, Sodium, or Sugar NNS, non-nutritive sweetener present in ingredient list Flavors/color, ≥1 color or flavor/flavor enhancer additive present in ingredient list. Additives = NNS, colors/flavors or other additives (Anti-foaming agent, Foaming agent, Bulking agent, Gelling agent, Thickener, Carbonating agent, Emulsifier, Emulsifying salt, Flavour enhancer, Glazing agent) present in ingredient list. Proportion of purchases based on volume (g/ml specified on product packaging) and calculated utilizing projection weights provided by NielsenIQ which takes into account the following factors: household size, income, household head age, race-ethnicity, education, occupation, presence of children, and county size. University of North Carolina calculations based in part on data reported by NielsenIQ through its Homescan Services for all food categories, including beverages and alcohol for 2020 across the U.S. market. NielsenIQ, 2021. The conclusions drawn from the data are those of UNC and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for and had no role in, and was not involved in, analyzing and preparing the results reported herein.

UPFs and HFSS products went from 16% using the classic HFSS criteria to 0% under proposed Approach #4 (HFSS + additives). Although the simplest approach would be to use Approach #2 (HFSS + flavors/colors) or #3 (HFSS + flavors/colors + NNS), Approach #4 (HFSS + additives) would be the most complete approach for policymakers to consider when trying to identify less healthy food and beverage products to target. The addition of NNS in Approach #3 was not found to significantly affect the proportion of product purchases that would be considered for policy, indicating that products containing NNS are likely to also contain one or more color or flavor additives.

Currently in the literature, there is no consistent application of the NOVA definition of UPFs, with researchers interpreting the approach in various ways.[25] There is therefore a need for a simple policy-ready definition of UPFs that considers not only the level of processing a product has but also its nutritional components. There are a number of recent state and national policies that have attempted to address UPFs. For example, the state of Massachusetts for its school lunch programs has tried to eliminate UPFs.[33] There is the Brazilian National School Feeding Program (PNAE), where only 20% of procurement for school foods can be used for processed foods and UPFs and 5% for culinary ingredients such as salt, oil, and sugar.[34] Some dietary guidelines now also include an element that focuses on processing, with more expected over the coming years.[33,35,36] We expect many more national dietary guidelines to discuss this topic in the future. With this will come an increasing demand for a simple, workable, and most importantly, accurate definition of UPFs that also ensures products high in saturated fats, sugars and salt are considered, especially due to the wide variation between the definitions used for UPFs in each of these country policies. More recently, the Colombian government created a tax on UPFs (10% in November 2023 going up to 15% a year later and 20% in 2025). However, Colombia is a good example to show how difficult using solely the NOVA approach to identification of UPFs is in a policy setting, with the tax eventually focusing solely on HFSS products and not considering level of processing.

In addition to NOVA and the classic HFSS criteria, other examples of systems aiming to identify less healthy foods and beverages include nutrient-based profiling models such as Nutri-Score, the Australasian Health Star Rating system, the Ofcom nutrient profile model, Traffic Light Labelling, the Choices model, and many others. These systems predominantly use nutrient information found on product packaging to determine a product's healthiness. The only one of these that is mandatory is Thailand's Choices model. Many of these systems (e.g., Nutri-Score, Traffic Lights) allow fiber, added proteins or other added elements to offset levels of sugar, sodium, and saturated fat. The problems with these systems are two-fold. First, based on current understanding of nutrition metabolism, it is biologically implausible that the addition of some nutrients of benefit would simply "offset" nutrients of concern. Second, these systems have limited utility for identifying both HFSS and UPFs (i.e., a food with 5 stars or an A rating can be ultra-processed).

A key limitation of this study is that households in NielsenIQ do not report whether all food and beverage purchases were consumed, and the amount of food waste may vary. Foods without barcodes could not be scanned and linked to purchases, so these items were excluded from analyses. Although misreporting is possible, the accuracy of the NielsenIQ data is comparable to other commonly used economic data sets. Another limitation is the retrospective nature of the data and data analysis with the NielsenIQ 2020 data now 4 years old. We also note that the approach we chose to classify HFSS, based on the Chilean government approach, is not the only approach to classifying these products. Other nutrient profiles, such as the Pan American Health Organization model, which is used in several countries, could also be explored in the future, though we anticipate that the results would be similar to our HFSS + NNS model, since the major differences between the PAHO model and the approach we used is the addition of NNS. An important limitation is also that currently there is no "gold standard" in identifying unhealthy foods to target for policy intervention, so the validity of what was found in this study is unknown. However, the study did use widely-accepted methods to identity UPFs and HFSS products. In addition, the FDA's Substances Added to Food Inventory acknowledges that the inventory is only a partial list of ingredients and so it is possible that we have underestimated the proportion of foods to be targeted in each of the approaches examined in this study. An important next step in future research would be to apply the alternative approaches outlined in this study to a national packaged food supply from a low-middle income country to ensure that the "gap" between the traditional NOVA definition of UPFs and the classic HFSS criteria is able to be closed. A key strength of the study is that by using what US households actually purchased, it reflects the products that are most dominant on the US food supply (vs. using food supply data in which each product, no matter how well or poorly selling, contributes equally).

A number of countries have now made food processing a major part of their dietary guidelines.[33,36] Alongside this, HFSS foods are increasingly becoming a target for policy intervention. This paper, which focuses on the US and its vast array of packaged food and beverage products, demonstrates how the combination of elements of the NOVA classification system to identify UPFs, and the now commonly-used HFSS criteria to identify less healthy products, can help ensure that policymakers have both a simple and accurate method for the identification of less healthy food and beverage products.

Contributors
E Dunford and B Popkin designed and conducted this research. D Miles analysed data. D Miles and B Popkin accessed and verified the data reported in the manuscript. E Dunford and B Popkin drafted the manuscript. B Popkin had primary responsibility for final content.

Data sharing statement
We are unable to share data from this study as data were used under license from NielsenIQ.

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Declaration of interests
Lindsey Smith Taillie reported receiving consulting fees from Resolve to Save Lives. Barry M Popkin reported receiving consulting fees from Resolve to Save Lives, the World Bank, and payment or honoraria from the International Congress of Nutrition, Tokyo plenary, the German Society of Obesity plenary, and the South American Nutrition Society Plenary. Elizabeth Dunford reported receiving consulting fees from UNC and The George Institute.

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Appendix A. Supplementary data
Supplementary data related to this article can be found at https://doi.org/10.1016/j.lana.2024.100713.

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