Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.

eMethods 1. Classification of Foods and Beverages in NHANES by NOVA

NOVA classification
The NOVA classification categorizes foods and beverages into 4 groups based on the nature, extent and purpose of the physical, biological and chemical processes they have undergone following separation from nature (eTable 1) [1].

Group 1. Unprocessed or minimally processed foods
Unprocessed foods or minimally processed foods are foods that have not been altered from their natural state, or have only undergone processes like removal of inedible or unwanted parts, fractioning, grinding, drying, fermentation, pasteurization, roasting, boiling, cooling, or freezing. The purpose of these processing is to preserve or keep the freshness of natural foods, to make foods safe or edible or more pleasant to consume. These foods do not contain added substances such as salt, sugar, oils, or fats, but may infrequently contain preservatives. Many unprocessed or minimally processed foods are prepared and cooked at home or in restaurant kitchens in combination with processed culinary ingredients as dishes or meals. Examples include whole grains, millets, wheat flour, fresh or frozen fruits and vegetables, unprocessed meats and poultries, eggs, fish, fresh and pasteurized milk, unflavored yogurt, legumes, nuts and seeds.

Unprocessed or minimally processed foods were further classified into the following subgroups:
- Grains
- Fruits and freshly squeezed fruit juices (including 100% fruit juices and baby food juices)
- Vegetables
- Meat (includes poultry)
- Milk and plain yoghurt
- Eggs
- Fish and seafood
- Other unprocessed or minimally processed foods

Group 2. Processed culinary ingredients
Processed culinary ingredients are substances extracted from the first NOVA group or from nature by processes such as pressing, grinding, crushing, pulverizing and refining. These ingredients are used for seasoning and cooking foods in the first group. Examples include salt, sugar, honey, vegetable oils, butter, lard, and vinegar, maple syrup (100%), molasses and honey.

Processed culinary ingredients were further classified into the following subgroups:
- Sugar
- Plant oils
- Animal fats
- Other processed culinary ingredients

Group 3. Processed foods
Processed foods are products manufactured by industry by adding salt, sugar, oil or other NOVA group 2 ingredients to unprocessed or minimally processed foods to preserve or make them more palatable. These foods may contain preservatives, antioxidant, and stabilizers. Examples include canned/bottled vegetables and legumes, fruits in syrup, canned fish and meats, cheeses, salted or sugared nuts and seeds, breads made of ingredients used in culinary preparations (i.e. wheat flour, yeast, water, salt, butter or sugar).

Processed foods were further classified into the following subgroups:
- Cheese
- Ham and other salted, smoked or canned meat or fish
- Vegetables, fruits and other plant foods preserved in brine, sugar or syrup
- Other processed foods (including wine and beer)

Group 4. Ultra-processed foods

Ultra-processed foods are ready-to-eat/drink/heat industrial formulations that are made with multiple industrial ingredients extracted from foods or synthesized in laboratories, while containing little whole foods. Besides salt, sugar, oils and fats, and preservatives, ultra-processed foods include ingredients not used in culinary preparations, in particular, flavors, colors, sweeteners, emulsifiers and other additives used to imitate sensorial qualities of unprocessed or minimally processed foods or to disguise undesirable aspects of the final product. The processes for making ingredients or final products of ultra-processed foods may include hydrogenation and hydroxylation, extrusion and molding, and pre-processing for frying. The overall purpose of ultra-processing is to create highly profitable, hyper-palatable ready to consume products with long shelf-life. Ultra-processed food products are usually packaged attractively and marketed intensively. Examples include carbonated drinks, fruit flavored drinks, sausages, biscuits, sweet/savory packaged snacks, candies, ready to eat/heat pizza, sandwich, or burger, frozen or shelf-stable dishes, instant soups/noodles. The detailed ultra-processed food subgroups and included food items are shown in eTable 1 in the supplement.

Classification of Foods and Beverages in NHANES Using NOVA

To assign a food or beverage in NAHNES into one of the four NOVA groups, we first assessed the main food description and corresponding ingredient list for each NHANES food code obtained from the cycle-specific USDA Food and Nutrition Database for Dietary Studies (FNDDS) and the USDA National Nutrient Database for Standard Reference (SR), respectively.[2,3] For hand-made recipes, the classification was applied to the underlying ingredients for a more accurate classification. The ingredients of branded food products, obtained from the USDA Branded Food Products Database or Fooducate (a free app and website that provide ingredient information for food products, as a second alternative)[4] were used when necessary to decide upon the food classification of certain food items.

Some foods codes containing mixed ingredients could be either handmade or industrially produced ultra-processed foods. Examples of these foods include bakery products such as cakes/cookies/pies, and mixed dishes such as sandwiches, burgers, pizza, and pasta dishes. These foods were classified directly as ultra-processed foods and relevant subgroups if they were indicated as branded, pre-prepared or ready-to-eat/heat/drink products according to "Main food Description," or contained ingredients not commonly used in culinary preparation except preservatives (according to SR code description or Fooducate database). Examples of these ingredients include modified starches, hydrogenated oils, protein isolates, colorants, flavorings, non-sugar sweeteners, emulsifiers, humectants, sequestrates, and firming, bulking, de-foaming, anti-caking, and glazing agents. If no indications for ultra-processing was identified for the food code, the classification was then applied to the underlying ingredients (SR codes) of that food code to enable a more precise classification. For example, each underlying ingredient of food code 'Pork and rice with tomato-based sauce' was assigned to a relevant category as follows: 'Pork, fresh, loin, whole, separable lean only, cooked, roasted' (unprocessed/minimally processed foods), 'Tomato products, canned, sauce' (processed food), 'Rice, white, long-grain, regular, enriched, cooked' (unprocessed/minimally processed foods), 'Vegetable oil, NFS' (processed culinary ingredient) and 'Salt, table' (processed culinary ingredient).

Thereafter, the classification was reviewed and modified as needed to take into account "Combination food type" and "Source of food" for each food recorded in NHANES. In this step, most food consumed as "Frozen meals" or "Lunchables" or food items acquired at a "Vending machine" or a "Fast food place" were reclassified as ultra-processed foods if not yet.

Absence of sufficient information to determine the degree of processing was generally solved by opting for the lesser degree of processing. For example, food code "Yogurt, NFS" was classified as unprocessed/minimally processed food. Homemade recipes with unknown ingredients were classified based on expected principal ingredients. For example, SR Code 'Restaurant, Chinese, sesame chicken' used to code the Food Code 'Orange chicken', was classified as 'meat' within unprocessed/minimally processed foods. This could slightly underestimate processed culinary ingredients or ultra-processed food consumption.

Under NOVA, foods in the same category can be classified into different groups. For example, plain rolled oats are minimally processed foods, while ready-breakfast cereals containing food substances rarely used in kitchens or classes of additives whose function is to make the final product palatable or appealing, such as flavors or colors are ultra-processed. Regarding bread, the classification distinguishes between handmade bread (either homemade or made in restaurants or artisanal bakeries), and industrial bread (made in industrial bakeries or factories) – which are either processed (when manufactured with ingredients used in culinary preparations, such as wheat flour, water, salt

and yeast) or ultra-processed (when manufactured with food substances not used in culinary preparations). Among the industrial bread that had fully known ingredients in NHANES (3.7% of the industrial bread in NHANES had fully known ingredients), the vast majority (97.7%) were manufactured with food substances not used in culinary preparations and thus ultra-processed. Therefore, we classified all industrial breads as ultra-processed foods. This may have slightly overestimated the proportion of industrial bread that are ultra-processed.

The same definition and classification procedure as stated above were used to classify foods across different NHANES survey cycles. The food codes and their relevant descriptions and ingredient list obtained from USDA FNDDS files were updated each two years, tied to the release of data from NHANES.[5] During the updates, new food codes could be added to reflect new food items and portion sizes reported and changes in marketplace. For example, pizza was among the food categories updated in FNDDS 4.1, and the updates further differentiated types of crust, extra toppings, and frozen pizzas. These updates may have partly contributed to a higher increase in the estimated consumption of ready-to-eat/heat mixed dishes between certain cycles, although a substantial influence on the overall trend is unlikely. As the purpose of the updates is to ensure that the food codes descriptions and ingredients to reflect the foods in the current marketplace, using cycle-specific FNDDS files shall allow more precise classification of foods and beverages in each NHANES cycle.

eMethods 2. Analytical Approach for Assessing Trends in Percent of Energy from NOVA Food Groups and Subgroups

To estimate the mean percent of energy intake from each NOVA food group and subgroup consumed by US children and adolescents, we calculated the population ratio of mean energy intake from each food group over the mean total energy for each NHANES cycle.[1] Population ratio is the recommended approach for assessing ratios of intakes from food groups/nutrients over total energy, which derive a score that is closer to the usual population intake ratio.[6] To generate nationally representative estimates of percent of energy from each NOVA food group and their standard errors for each cycle, the PROC SURVEYMEANS function from SAS programming language was used to incorporate appropriate sampling weight and complex survey design.

To examine trends in the percent of energy intake from each NOVA food group, linear regression models were used with percent of energy from various groups as a predicted variable, and NHANES two-year survey cycle as a continuous predictor (e.g., 1=1999-2000, 2=2001-2002,..., 10=2017-2018) in the model. The weighted least-square regression was used to fit the linear trend model for the estimated mean percent of energy with their standard error incorporated,[7] using PROC REG function specifying WEIGHT. For nonlinearity assessment, the quadratic term of survey cycle was further added to the model to examine the nonlinearity of the trend. *P*-values for all quadratic terms were greater than 0.05, suggesting no significant non-linear trends in the consumption of each NOVA food group.[8] Model assumption was further evaluated by inspecting the diagnostic plots. The residual plot for the weighted least square regression showed that the residuals were randomly dispersed around the horizontal axis, suggesting that there is no evidence for violation for the homoscedasticity assumption for assessing trends in percent of energy from ultra-processed foods using linear regression model (Text A). The QQ-plot for the weighted least square regression showed that observations lie well along the 45-decree line in the QQ-plot, supporting the linearity assumption (Text A). The R^2 from the linear regression model was 0.87. These results supported that the use of linear regression model can adequately assess the trends in ultra-processed food consumption in US children and adolescents. Therefore, all analyses presented were based on linear regression models with a linear time term.

Text A. Diagnostic Plot for Trends in Percent of Energy Intake from Ultra-Processed Foods in Survey-Weighted Linear Regression Model (Left: Residual plot; Right: Q-Q plot)
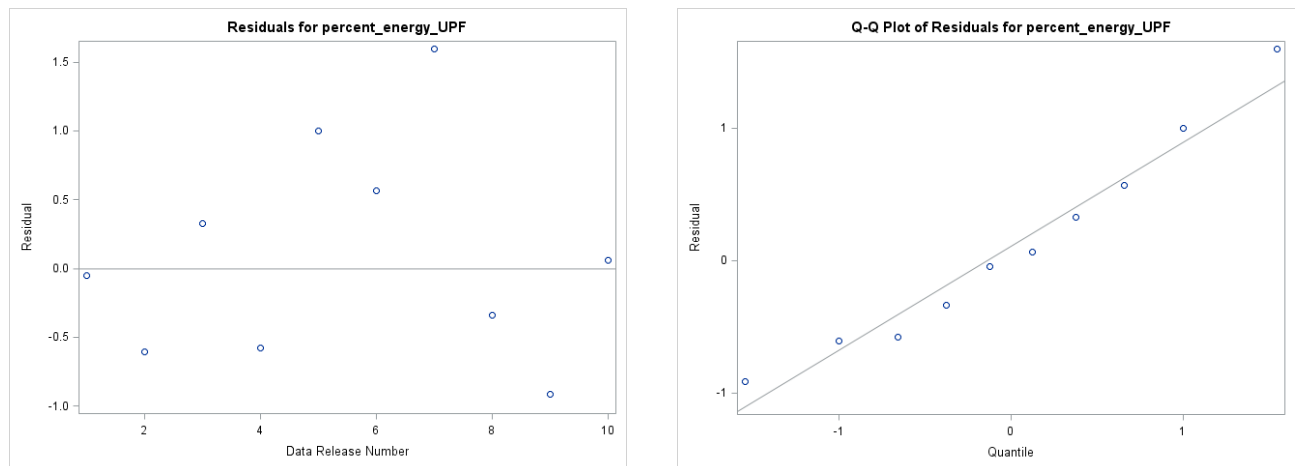
eTable 1. Ultra-Processed Food Subgroups and Example Foods

Ultra-Processed Food Subgroups	Foods or Beverages Included
Industrial grain foods	
Breads, rolls and tortillas	Yeast breads (white/whole wheat/wheat/rye/oat/multigrain bread), rolls, buns, bagels, English muffins, tortillas, pita bread, taco shells (baked) that are not homemade or acquired from bakery store
Biscuits, muffins, and quick breads	Biscuits, cornbread, muffins and other quick breads that are "ready-to-eat", "commercially prepared", "made from mix", or contain non-culinary ingredients
Pancakes, waffles and French toasts	Pancakes, waffles and French toasts that are ready-to-eat or contain non-culinary ingredients
Ready-to-eat breakfast cereals	Ready-to-eat cereals that contains classes of additives whose function is to make the final product palatable or appealing, such as flavors or colors.
Ready-to-eat/heat mixed dishes	
Ready-to-eat/heat pizza	Pizza or pizza dough indicated as from "fast food", "pizza chains", "frozen", "school lunch", and "pizza rolls", or contain non-culinary ingredients
Ready-to-eat/heat sandwiches and burgers on bun	Sandwiches or burgers (cheeseburger, hamburger or chicken burger) indicated as from fast food, or from frozen, or contain non-culinary ingredients
Other ready-to-eat/heat mixed dishes	Meat/seafood/poultry/egg mixed dishes, grain based mixed dishes (pasta dishes, rice dishes, macaroni and cheese, turnovers, and other), Mexican mixed dishes, Asia mixed dishes, and soups, when indicated as frozen, microwaved, prepared, canned, boxed, fast food, preheated, or contain non-culinary ingredients.
Snacks and Sweets	
Savory snacks	Crackers; flavored popcorns (excluding plain air-popped popcorn); chips (potato/vegetable/corn/tortilla/other); pretzels/snack mix
Sweat bakery products	Cakes and pies; cookies and brownies; doughnuts, sweet rolls, and pastries that are ready-to-eat, commercially prepared, made from mix, frozen, or contain non-culinary ingredients
Candies	Candies, chocolate, chewing gums
Cereal or nutrition bars	Cereal or nutrition bars (cereal/energy/protein/meal replacement bars)
Ice cream and desserts	Ice creams and other frozen dairy desserts; ready-to-eat or dry mixed dairy desserts (such as pudding); fruit disserts; jellies and jams and preserves; toppings; gelatin desserts
Sugar-sweetened and diet beverages	
Sugar-sweetened and diet soft drinks	Sugar sweetened and diet soda
Fruit drinks and other sweetened drinks	Fruit drinks, sport/energy drinks, nutrition drinks

Ultra-Processed Food Subgroups	Foods or Beverages Included
Flavored dairy foods and dairy substitutes	
Flavored milk	Flavored milk
Flavored yogurts	Flavored yogurts
Dairy drinks and dairy substitutes	Milk shake and other dairy drinks, dairy substitutes such as almond milk, coconut milk, rice drink, soy milk
Other	
Fast-food or reconstituted meat, poultry, and fish products	Fast food meat patties/fried chicken/fish sticks, patties, or fillets; chicken nugget; sausages, ham, lunchmeats; meat spreads; beef/port/other meat jerky
Fast food or pre-prepared potato products	Fast food /pre-prepared /frozen French fries, hash browns, potato puffs, stuffed potatoes
Fats, condiment and sauces	Industrial fats, margarine, light or fat free cream /whipped cream, cream substitutes, light or fat free cream cheese, cheese spread; salad dressings, tomato based/soy-based/other condiments; dips, gravies, and other sauces
Other ultra-processed foods	Including soy products such as meatless patties and fish sticks; sweeteners, and all syrups (excluding 100% maple syrup); distilled alcoholic drinks, baby formula. and onion rings

eTable 2. Estimated Percent of Energy from NOVA Food Groups Among US Children Aged 2-19 Years by NHANES Survey Cycle, 1999-2000 to 2017-2018

NOVA Food Groups and Subgroups	Estimated Mean (95% CI) of Percent of Energy (%) Consumed from Each Food Group									
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018
	(n=3833)	(n=4288)	(n=3824)	(n=4029)	(n=3109)	(n=3280)	(n=3132)	(n=3020)	(n=2900)	(n=2380)
Unprocessed or minimally processed foods	28.8 (27.0-30.7)	29.6 (28.6-30.6)	28.0 (26.8-29.1)	27.3 (26.3-28.3)	26.9 (25.4-28.3)	26.7 (24.9-28.4)	25.0 (23.6-26.3)	25.7 (24.4-27)	24.6 (23.3-25.8)	23.5 (22.3-24.7)
Meats, poultry, fish, and eggs	7.2 (6.4-7.9)	8.0 (7.4-8.5)	7.7 (7.2-8.1)	7.8 (7.2-8.4)	8.3 (7.5-9.0)	7.8 (7.0-8.5)	7.0 (6.4-7.5)	7.6 (6.7-8.5)	7.1 (6.5-7.8)	6.4 (5.8-7.1)
Milk and plain yogurts	7.1 (6.6-7.5)	7.7 (7.1-8.2)	7.2 (6.5-7.8)	6.5 (6.1-6.9)	6.5 (6-6.9)	6.7 (6.4-6.9)	6.4 (5.8-6.9)	5.8 (5.4-6.3)	5.5 (4.9-6.1)	5.1 (4.8-5.5)
Fruits	4.1 (3.7-4.5)	4.2 (3.8-4.6)	4.3 (3.9-4.7)	4.3 (3.9-4.7)	4.9 (4.4-5.4)	4.8 (4.2-5.3)	4.6 (4.0-5.2)	4.6 (4.2-4.9)	4.3 (3.9-4.7)	4.8 (4.2-5.5)
Grains [a]	7.7 (6.8-8.5)	7.3 (6.6-8.1)	6.4 (5.9-6.9)	6.5 (5.7-7.2)	4.7 (4.2-5.2)	5.1 (4.4-5.9)	4.5 (4.0-5.1)	4.8 (4.4-5.3)	4.9 (4.3-5.6)	4.5 (4.0-5.1)
Vegetables	1.7 (1.5-2.0)	1.6 (1.4-1.7)	1.5 (1.3-1.7)	1.4 (1.2-1.6)	1.5 (1.3-1.7)	1.2 (1.1-1.4)	1.3 (1.1-1.5)	1.4 (1.2-1.5)	1.5 (1.3-1.8)	1.3 (1.2-1.4)
Nuts/seeds/legumes	0.9 (0.7-1.1)	0.6 (0.5-0.7)	0.8 (0.6-1.0)	0.5 (0.4-0.6)	0.7 (0.5-0.9)	0.8 (0.6-1.0)	0.7 (0.6-0.9)	1.0 (0.7-1.4)	1.0 (0.8-1.1)	1.0 (0.7-1.3)
other unprocessed foods [b]	0.2 (0.2-0.3)	0.2 (0.2-0.3)	0.2 (0.2-0.2)	0.2 (0.2-0.3)	0.3 (0.2-0.4)	0.3 (0.2-0.3)	0.5 (0.3-0.6)	0.4 (0.4-0.5)	0.3 (0.2-0.4)	0.3 (0.2-0.3)
Processed culinary ingredients	2.4 (2.1-2.7)	2.4 (2.2-2.6)	2.3 (2.1-2.5)	2.9 (2.5-3.3)	2.2 (2-2.4)	2.2 (2-2.4)	2.4 (2.1-2.8)	2.9 (2.6-3.2)	3.4 (3.1-3.6)	3.4 (3.1-3.7)
Plant oils	1.2 (0.9-1.4)	1.0 (0.8-1.2)	1.0 (0.9-1.1)	1.0 (0.9-1.2)	0.9 (0.7-1)	0.8 (0.7-0.9)	0.6 (0.4-0.9)	0.4 (0.3-0.5)	0.6 (0.5-0.7)	0.5 (0.3-0.6)

NOVA Food Groups and Subgroups	Estimated Mean (95% CI) of Percent of Energy (%) Consumed from Each Food Group									
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018
	(n=3833)	(n=4288)	(n=3824)	(n=4029)	(n=3109)	(n=3280)	(n=3132)	(n=3020)	(n=2900)	(n=2380)
Animal fats [c]	0.6	0.7	0.4	0.5	0.5	0.7	1.0	1.4	1.5	1.6
	(0.5-0.7)	(0.5-0.8)	(0.4-0.5)	(0.4-0.6)	(0.4-0.6)	(0.6-0.9)	(0.9-1.2)	(1.2-1.6)	(1.3-1.6)	(1.4-1.8)
Sugar [d]	0.6	0.6	0.8	1.3	0.7	0.7	0.7	1.1	1.3	1.3
	(0.5-0.7)	(0.5-0.7)	(0.7-0.9)	(1.1-1.5)	(0.6-0.8)	(0.6-0.8)	(0.6-0.9)	(0.9-1.2)	(1.1-1.4)	(1.2-1.5)
Processed foods	6.1	6.5	6.7	7.1	6.0	6.0	5.9	6.0	6.6	6.0
	(5.6-6.5)	(6.0-7.1)	(6.1-7.3)	(6.3-7.8)	(5.5-6.5)	(5.4-6.7)	(5.0-6.7)	(5.5-6.4)	(6.0-7.3)	(5.6-6.5)
Cheese	3.2	3.3	3.5	3.6	3.0	2.8	2.9	3.1	3.2	3.1
	(2.8-3.5)	(2.9-3.7)	(3.2-3.9)	(3.2-4.0)	(2.4-3.5)	(2.6-3.1)	(2.4-3.3)	(2.8-3.5)	(2.7-3.7)	(2.7-3.4)
Canned/smoked/cured meats and fish	0.6	0.7	0.6	0.7	0.6	0.7	0.7	0.6	0.6	0.7
	(0.4-0.7)	(0.6-0.8)	(0.5-0.7)	(0.5-0.9)	(0.5-0.8)	(0.6-0.8)	(0.5-0.9)	(0.4-0.8)	(0.5-0.7)	(0.5-0.8)
Canned fruits and vegetables	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.4
	(0.7-0.9)	(0.7-0.9)	(0.6-0.9)	(0.6-0.8)	(0.5-0.8)	(0.6-0.7)	(0.5-0.6)	(0.4-0.6)	(0.5-0.6)	(0.3-0.5)
Other processed foods [e]	1.5	1.8	1.8	2.0	1.7	1.8	1.7	1.8	2.2	2.0
	(1.1-1.9)	(1.4-2.2)	(1.4-2.3)	(1.7-2.4)	(1.4-2.0)	(1.4-2.3)	(1.4-2.0)	(1.5-2.1)	(1.9-2.5)	(1.7-2.3)
Ultra-processed foods	61.4	61.5	63.0	62.7	64.9	65.1	66.7	65.4	65.4	67.0
	(59.7-63.2)	(60.4-62.6)	(61.9-64.1)	(61.3-64.1)	(63.5-66.4)	(63.4-66.8)	(65-68.5)	(64.1-66.7)	(64.1-66.7)	(65.8-68.2)
Industrial grain foods [f]	13.8	14.2	14.2	13.6	13.8	14.0	14.2	14.4	14.7	14.5
	(12.8-14.7)	(13.6-14.9)	(13.6-14.8)	(12.9-14.2)	(13.1-14.5)	(13.3-14.6)	(13.1-15.2)	(13.8-14.9)	(13.4-15.9)	(13.6-15.5)
Ready-to-eat/heat mixed dishes [g]	2.2	1.7	4.6	6.3	9.4	11.4	11.2	11.7	12.6	11.1
	(1.8-2.6)	(1.4-1.9)	(4.0-5.2)	(5.4-7.1)	(8.6-10.3)	(10.5-12.2)	(9.4-13)	(11-12.4)	(11.5-13.6)	(9.9-12.4)
Sweet snacks and sweets [h]	10.6	11.6	10.6	11.7	11.4	10.9	12.0	12.0	12.6	12.9
	(9.8-11.5)	(11.0-12.3)	(9.9-11.3)	(10.9-12.5)	(10.6-12.1)	(10.1-11.8)	(11.1-12.9)	(11.2-12.8)	(11.5-13.7)	(11.9-13.9)
Savory snacks [i]	5.7	6.0	5.9	5.7	6.1	6.0	5.8	6.0	6.3	6.3

NOVA Food Groups and Subgroups	Estimated Mean (95% CI) of Percent of Energy (%) Consumed from Each Food Group									
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018
	(n=3833)	(n=4288)	(n=3824)	(n=4029)	(n=3109)	(n=3280)	(n=3132)	(n=3020)	(n=2900)	(n=2380)
	(5.2-6.2)	(5.6-6.4)	(5.6-6.2)	(5.3-6.2)	(5.4-6.9)	(5.6-6.4)	(5.4-6.3)	(5.4-6.7)	(5.9-6.7)	(5.6-7.0)
Fast-food or reconstituted meat/poultry/fish [j]	5.6	5.5	5.1	4.9	4.7	3.8	5.3	5.2	5.3	6.7
	(5.0-6.3)	(5.2-5.9)	(4.7-5.5)	(4.3-5.5)	(4.2-5.1)	(3.3-4.2)	(4.7-5.8)	(4.4-5.9)	(4.9-5.7)	(5.9-7.4)
Sugar-sweetened beverages [k]	10.8	10.0	10.2	9.1	8.3	8.0	7.7	6.3	5.3	5.3
	(9.9-11.7)	(9.4-10.6)	(9.4-11)	(8.2-10)	(7.6-9)	(7.2-8.7)	(7.2-8.2)	(5.7-6.8)	(4.9-5.6)	(4.9-5.8)
Processed fats/oils, condiment and sauces [l]	7.1	6.6	6.8	5.8	5.6	5.1	4.6	3.8	3.7	4.0
	(6.7-7.5)	(6.4-6.8)	(6.4-7.1)	(5.5-6.1)	(5.1-6)	(4.7-5.4)	(4.1-5.2)	(3.4-4.2)	(3.4-4)	(3.6-4.3)
Flavored dairy foods and dairy substitutes [m]	2.0	2.5	2.4	2.4	2.7	3.3	3.0	2.9	2.4	2.6
	(1.6-2.4)	(2.2-2.8)	(2.0-2.8)	(2.1-2.8)	(2.3-3.1)	(2.8-3.7)	(2.5-3.4)	(2.6-3.3)	(2.1-2.8)	(2.3-2.9)
Fast-food or pre-prepared French Fries or other potato products [n]	2.7	2.6	2.5	2.4	2.2	2.2	2.1	1.8	1.5	1.9
	(2.3-3.1)	(2.3-2.8)	(2.1-2.9)	(2.1-2.7)	(1.9-2.6)	(1.9-2.5)	(1.6-2.7)	(1.5-2.1)	(1.2-1.7)	(1.7-2.1)
Other ultra-processed foods [o]	0.8	0.7	0.7	0.7	0.6	0.6	0.9	1.3	1.1	1.5
	(0.5-1.2)	(0.6-0.9)	(0.5-1.0)	(0.6-0.9)	(0.4-0.8)	(0.4-0.7)	(0.5-1.2)	(0.7-1.8)	(0.9-1.2)	(1.2-1.9)

Abbreviation: NHANES, National Health and Nutrition Examination Survey; 95% CI, 95% confidence intervals.

[a] Including dry, raw or cooked whole grain and bran of rice, oat, corns, wheat, quinoa, rye, and white rice; pasta; grain flours.

[b] Including yeast; dried fruits without added sugars and dried vegetables; non-flavored coffee and tea; coconut water and meat; homemade soup and sauces.

[c] Including butter, lard, and creams

[d] Including sugar (brown, granulated, or powered), honey, molasses, and maple syrup (100%) that are added to cook un-processed or minimally processed food (at home or restaurants).

[e] Including salted or sugared nuts and seeds; peanut, sesame, cashew and almond butter or spread; beer and wine.

[f] Including industrial breads, rolls and tortillas; biscuits, muffins, and quick breads; pancakes, waffles; French toasts; and breakfast cereals.

[g] Including ready-to-eat/heat pizza, ready-to-eat/heat sandwich and hamburgers, and other ready-to-eat/heat mixed dishes.

[h] Including sweet bakery products; candies; cereal and nutrition bars; ice creams, ice pops, frozen yogurts; other disserts such as pudding, fruit desserts, gelatin desserts.

[i] Including crackers, chips, and popcorns.

[j] Including fast food meat patties/fried chicken/fish sticks, patties, or fillets; chicken nugget; sausages, ham, lunchmeats; meat spreads; beef/port/other meat jerky.

[k] Including sugar-sweetened soft drinks and diet soft drinks; fruit drink and other sweetened drinks such as energy drinks, sports drinks, nonalcoholic wine.

[l] Including sauces, dressings, gravies, dips, spreads, mustard, and catsup, light creams and cream substitutes, margarine, industrial fats.

[m] Including flavored milk, flavored yogurts, milk shakes and other dairy drinks, and dairy substitutes.

[n] Including fast food, pre-prepared or frozen French fries/ other potato products such as hash browns, potato puffs, stuffed potatoes.

[o] Including soy products such as meatless patties; sugar substitutes, sweeteners, and all syrups (excluding 100% maple syrup); distilled alcoholic drinks.

eTable 3. Trends in Estimated Percent of Energy (%) from NOVA Food Groups After Adjustment of Age, Sex and Race/Ethnicity Among US Children Aged 2-19 Years by NHANES Survey Cycle, 1999-2000 to 2017-2018

	Estimated Mean (95% CI) of Percent of Energy (%) from Each NOVA Food Group[a]										P-trend[a]	Difference, 2017-2018 vs. 1999-2000
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018		
	(n=3833)	(n=4288)	(n=3824)	(n=4029)	(n=3109)	(n=3280)	(n=3132)	(n=3020)	(n=2900)	(n=2380)		Mean (95% CI)
Unprocessed or minimally processed foods	31.0 (29.3-32.7)	31.7 (30.4-32.9)	30.6 (29.3-31.8)	30.1 (29.2-31.0)	29.6 (28.7-30.6)	28.8 (27.4-30.2)	27.0 (25.9-28.0)	27.2 (25.8-28.6)	26.3 (25.4-27.2)	24.7 (23.4-26.0)	<.001	-5.51 (-7.67 to -3.35)
Meats, poultry, fish, and eggs	7.7 (7.1-8.3)	8.5 (8.1-9.0)	8.8 (8.4-9.2)	8.6 (8.1-9.2)	8.8 (8.2-9.4)	8.4 (7.7-9.1)	7.3 (6.9-7.7)	7.4 (6.7-8.1)	7.4 (7.0-7.9)	6.5 (6.0-7.0)	<.001	-0.80 (-1.71 to 0.12)
Milk and plain yogurts	7.6 (7.1-8.1)	8.0 (7.6-8.3)	7.3 (6.8-7.8)	7.2 (6.8-7.6)	6.9 (6.5-7.2)	6.8 (6.5-7.0)	6.8 (6.4-7.1)	6.2 (5.8-6.5)	5.9 (5.5-6.4)	5.5 (5.2-5.9)	<.001	-1.93 (-2.52 to -1.33)
Fruits	4.6 (4.2-5.1)	4.9 (4.6-5.2)	5.2 (4.7-5.8)	5.2 (4.9-5.6)	6.0 (5.6-6.4)	5.8 (5.2-6.3)	5.3 (4.9-5.7)	5.4 (5-5.7)	5.0 (4.7-5.3)	5.5 (4.8-6.2)	.08	0.66 (-0.11 to 1.43)
Grains [b]	8.1 (6.9-9.2)	7.6 (6.8-8.4)	6.5 (5.9-7.1)	6.4 (5.9-6.9)	5.5 (5.1-5.8)	5.3 (4.8-5.8)	4.9 (4.3-5.4)	5.2 (4.7-5.7)	5.1 (4.6-5.7)	4.7 (4.3-5.1)	<.001	-3.04 (-4.11 to -1.97)
Vegetables	1.8 (1.5-2.0)	1.6 (1.5-1.8)	1.6 (1.4-1.7)	1.6 (1.4-1.8)	1.4 (1.2-1.6)	1.3 (1.1-1.5)	1.3 (1.2-1.5)	1.4 (1.3-1.6)	1.6 (1.4-1.7)	1.3 (1.2-1.4)	.005	-0.44 (-0.74 to -0.15)
Nuts/seeds/legumes	1.0 (0.8-1.2)	0.7 (0.7-0.8)	0.9 (0.8-1.1)	0.7 (0.6-0.8)	0.7 (0.6-0.8)	0.9 (0.6-1.1)	0.9 (0.7-1.0)	1.1 (0.9-1.2)	1.0 (0.9-1.1)	0.9 (0.6-1.2)	.06	-0.02 (-0.28 to 0.24)
other unprocessed foods [c]	0.2 (0.2-0.3)	0.3 (0.2-0.4)	0.3 (0.2-0.3)	0.3 (0.2-0.4)	0.4 (0.3-0.5)	0.3 (0.3-0.4)	0.5 (0.4-0.6)	0.5 (0.4-0.6)	0.3 (0.2-0.4)	0.3 (0.2-0.4)	<.001	0.06 (-0.01 to 0.13)
Processed culinary ingredients	2.3 (2.1-2.5)	2.2 (2.0-2.4)	2.2 (2-2.5)	2.7 (2.5-2.9)	2.1 (1.9-2.3)	2.2 (1.9-2.4)	2.5 (2.3-2.6)	2.9 (2.6-3.1)	3.5 (3.2-3.7)	3.2 (2.9-3.6)	<.001	0.99 (0.64 to 1.34)
Plant oils	0.6 (0.5-0.7)	0.6 (0.5-0.7)	0.5 (0.4-0.6)	0.5 (0.5-0.6)	0.6 (0.5-0.6)	0.8 (0.6-0.9)	1.2 (1.1-1.3)	1.5 (1.4-1.7)	1.7 (1.5-1.8)	1.6 (1.5-1.8)	<.001	0.93 (0.77 to 1.1)
Animal fats [d]	0.6 (0.5-0.6)	0.6 (0.5-0.7)	0.7 (0.6-0.8)	1.1 (1.0-1.2)	0.6 (0.6-0.7)	0.6 (0.5-0.7)	0.7 (0.6-0.7)	0.9 (0.8-1.0)	1.2 (1.0-1.3)	1.2 (1.0-1.3)	<.001	0.74 (0.53 to 0.95)
Sugar [e]	1.1 (0.9-1.2)	0.9 (0.8-1.1)	1.0 (0.9-1.1)	0.9 (0.8-1.1)	0.8 (0.7-1.0)	0.8 (0.6-0.9)	0.6 (0.5-0.7)	0.4 (0.3-0.5)	0.6 (0.5-0.7)	0.4 (0.3-0.5)	<.001	-0.65 (-0.84 to -0.46)
Processed foods	5.6 (5.2-5.9)	5.9 (5.5-6.4)	5.8 (5.5-6.2)	6.0 (5.6-6.4)	5.2 (4.8-5.6)	5.5 (5.1-5.9)	5.2 (4.6-5.8)	5.4 (5-5.8)	6.1 (5.7-6.6)	5.6 (5.2-6.0)	.99	0.03 (-0.53 to 0.59)
Cheese	3.0 (2.7-3.2)	3.0 (2.7-3.4)	3.0 (2.8-3.3)	3.1 (2.9-3.4)	2.5 (2.1-2.9)	2.7 (2.5-2.9)	2.6 (2.2-3)	2.9 (2.5-3.2)	2.8 (2.5-3.1)	2.8 (2.4-3.2)	.34	-0.04 (-0.51 to 0.42)
Canned/smoked/cured meats and fish	0.6 (0.5-0.7)	0.7 (0.6-0.8)	0.6 (0.5-0.8)	0.6 (0.5-0.8)	0.6 (0.5-0.7)	0.6 (0.5-0.7)	0.6 (0.5-0.7)	0.6 (0.5-0.7)	0.6 (0.6-0.7)	0.7 (0.5-0.8)	.79	0.04 (-0.16 to 0.24)
Canned fruits and vegetables	0.8 (0.7-0.9)	0.8 (0.7-1.0)	0.8 (0.7-0.9)	0.7 (0.7-0.8)	0.7 (0.6-0.7)	0.7 (0.6-0.7)	0.6 (0.5-0.7)	0.5 (0.4-0.6)	0.7 (0.6-0.8)	0.5 (0.4-0.6)	<.001	-0.4 (-0.54 to -0.26)
Other processed foods [f]	1.2 (0.9-1.4)	1.4 (1.1-1.6)	1.4 (1.1-1.6)	1.5 (1.3-1.6)	1.4 (1.2-1.6)	1.5 (1.2-1.8)	1.3 (1.1-1.6)	1.5 (1.2-1.7)	1.9 (1.6-2.2)	1.7 (1.4-2.0)	<.001	0.51 (0.15 to 0.88)
Ultra-processed foods	59.6 (57.9-61.3)	60.2 (59-61.4)	61.4 (60.1-62.6)	61.2 (60.3-62.1)	63.1 (62-64.2)	63.6 (62.1-65)	65.3 (64-66.7)	64.6 (63.3-65.9)	64.1 (63.1-65.2)	66.4 (65.0-67.8)	<.001	5.72 (3.59 to 7.84)
Industrial grain foods [g]	13.9 (13.0-14.8)	14.4 (13.9-14.9)	14.3 (13.7-14.8)	14.1 (13.5-14.8)	14.2 (13.6-14.8)	13.9 (13.4-14.4)	14.6 (13.8-15.3)	14.2 (13.7-14.7)	14.4 (13.8-15.1)	14.6 (13.8-15.4)	.43	0.38 (-0.98 to 1.73)

	Estimated Mean (95% CI) of Percent of Energy (%) from Each NOVA Food Group[a]										P-trend[a]	Difference, 2017-2018 vs. 1999-2000
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018		
	(n=3833)	(n=4288)	(n=3824)	(n=4029)	(n=3109)	(n=3280)	(n=3132)	(n=3020)	(n=2900)	(n=2380)		Mean (95% CI)
Ready-to-eat/heat mixed dishes [h]	2.4 (2.1-2.8)	2.1 (1.8-2.4)	4.3 (3.8-4.8)	5.9 (5.5-6.2)	8.5 (8-9.1)	11.1 (10.1-12.1)	10.5 (9.1-11.9)	11.8 (11.1-12.4)	12.4 (11.2-13.6)	10.9 (9.7-12.2)	<.001	8.43 (7.24 to 9.62)
Sweet snacks and sweets [i]	9.4 (9.0-9.9)	10.3 (9.6-11.0)	10.4 (9.8-10.9)	10.7 (10.3-11.1)	10.5 (9.9-11.1)	10.0 (9.5-10.5)	11.3 (10.5-12.1)	11.2 (10.4-11.9)	11.2 (10.5-12)	12.1 (11.5-12.8)	<.001	2.49 (1.57 to 3.42)
Savory snacks [j]	5.4 (5.0-5.9)	5.8 (5.5-6.1)	5.8 (5.5-6.2)	5.8 (5.4-6.2)	6 (5.5-6.5)	6 (5.6-6.4)	5.9 (5.4-6.3)	6.2 (5.7-6.7)	6.5 (6.1-6.9)	6.6 (6-7.3)	.001	1.04 (0.32 to 1.75)
Fast-food or reconstituted meat/poultry/fish [k]	5.6 (5.0-6.2)	5.7 (5.3-6.0)	5.0 (4.7-5.3)	4.8 (4.4-5.3)	4.7 (4.3-5.1)	3.9 (3.5-4.2)	5.6 (5.1-6.1)	5.3 (4.7-5.9)	5.8 (5.3-6.2)	6.8 (6.2-7.3)	.01	1.14 (0.31 to 1.97)
Sugar-sweetened beverages [l]	10.8 (9.9-11.7)	9.9 (9.4-10.4)	9.9 (9.2-10.6)	8.8 (8.3-9.3)	8.1 (7.5-8.6)	7.8 (7.2-8.5)	7.5 (7.0-8.0)	6.4 (5.8-7.1)	5.4 (5.1-5.8)	5.5 (5-5.9)	<.001	-5.38 (-6.48 to -4.27)
Processed fats/oils, condiment and sauces [m]	6.7 (6.3-7.2)	6.4 (6.2-6.6)	6.3 (6.0-6.6)	5.5 (5.3-5.7)	5.4 (5.1-5.7)	4.8 (4.5-5.0)	4.3 (4.0-4.6)	3.6 (3.3-3.9)	3.5 (3.3-3.7)	3.8 (3.5-4.1)	<.001	-3.01 (-3.59 to -2.43)
Flavored dairy foods and dairy substitutes [n]	2.1 (1.8-2.4)	2.4 (2.1-2.8)	2.3 (2.0-2.7)	2.5 (2.3-2.8)	2.7 (2.5-3.0)	3.1 (2.8-3.5)	2.9 (2.6-3.3)	2.7 (2.4-3)	2.3 (2-2.7)	2.5 (2.2-2.8)	.002	0.58 (0.12 to 1.04)
Fast-food or pre-prepared French Fries or other potato products [o]	2.5 (2.2-2.7)	2.7 (2.4-3.1)	2.4 (2.1-2.6)	2.4 (2.2-2.7)	2.2 (1.9-2.6)	2.3 (2.0-2.7)	2.1 (1.8-2.3)	1.9 (1.6-2.2)	1.6 (1.4-1.8)	2.0 (1.7-2.3)	<.001	-0.74 (-1.10 to -0.38)
Other ultra-processed foods [p]	0.6 (0.5-0.8)	0.5 (0.4-0.6)	0.6 (0.5-0.7)	0.6 (0.5-0.7)	0.6 (0.4-0.8)	0.5 (0.4-0.6)	0.7 (0.4-0.9)	1.1 (0.7-1.5)	0.8 (0.7-1)	1.4 (1.1-1.8)	<.001	0.76 (0.32 to 1.21)

Abbreviation: NHANES, National Health and Nutrition Examination Survey; 95% CI, 95% confidence intervals.

[a] Estimations were generated from linear regression models adjusting for age, sex, and race/ethnicity.

[b] Including dry, raw or cooked whole grain and bran of rice, oat, corns, wheat, quinoa, rye, and white rice; pasta; grain flours.

[c] Including yeast; dried fruits without added sugars and dried vegetables; non-flavored coffee and tea; coconut water and meat; homemade soup and sauces.

[d] Including butter, lard, and cream.

[e] Including sugar (brown, granulated, or powered), honey, molasses, and maple syrup (100%) that are added to cook un-processed or minimally processed food (at home or restaurants).

[f] Including salted or sugared nuts and seeds; peanut, sesame, cashew and almond butter or spread; beer and wine.

[g] Including industrial breads, rolls and tortillas; biscuits, muffins, and quick breads; pancakes, waffles; French toasts; and breakfast cereals.

[h] Including ready-to-eat/heat pizza, ready-to-eat/heat sandwich and hamburgers, and other ready-to-eat/heat mixed dishes.

[i] Including sweet bakery products; candies; cereal and nutrition bars; ice creams, ice pops, frozen yogurts; other disserts such as pudding, fruit desserts, gelatin desserts.

[j] Including crackers, chips, and popcorns.

[k] Including fast food meat patties/fried chicken/fish sticks, patties, or fillets; chicken nugget; sausages, ham, lunchmeats; meat spreads; beef/port/other meat jerky.

[l] Including sugar-sweetened soft drinks and diet soft drinks; fruit drink and other sweetened drinks such as energy drinks, sports drinks, nonalcoholic wine.

[m] Including sauces, dressings, gravies, dips, spreads, mustard, and catsup, light creams and cream substitutes, margarine, industrial fats.

[n] Including flavored milk, flavored yogurts, milk shakes and other dairy drinks, and dairy substitutes.

[o] Including fast food, pre-prepared or frozen French fries/ other potato products such as hash browns, potato puffs, stuffed potatoes.

[p] Including soy products such as meatless patties; sugar substitutes, sweeteners, and all syrups (excluding 100% maple syrup); distilled alcoholic drinks.

eTable 4. Trends in Percent of Energy (%) Consumed from Ultra-Processed Food Subgroup Among US Children Aged 2-19 Years, 1999-2018

	Estimated Mean (95% CI) of Percent of Energy (%) Consumed from Ultra-Processed Food Subgroup										*P-trend*	Difference, 2017-2018 vs. 1999-2000
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018		
	(n=3833)	(n=4288)	(n=3824)	(n=4029)	(n=3109)	(n=3280)	(n=3132)	(n=3020)	(n=2900)	(n=2380)		Mean (95% CI)
Industrial grain foods												
Breads, rolls tortillas	8.0 (7.1-8.9)	7.8 (7.4-8.2)	8.4 (8.0-8.9)	7.3 (6.8-7.8)	7.7 (7.0-8.3)	7.6 (6.9-8.2)	8.7 (8.0-9.3)	8.7 (8.1-9.3)	8.5 (7.7-9.3)	8.7 (8.0-9.4)	.10	0.67 (-0.47 to 1.82)
Read-to-eat breakfast cereals	4.0 (3.6-4.4)	4.2 (3.7-4.7)	3.6 (3.3-3.9)	3.3 (3.1-3.6)	3.2 (2.9-3.4)	3.1 (2.6-3.5)	3.0 (2.8-3.3)	3.0 (2.6-3.3)	3.2 (2.9-3.6)	3.2 (2.9-3.6)	.010	-0.83 (-1.35 to -0.30)
Biscuits, muffins and quick breads	1.0 (0.8-1.2)	1.4 (1.2-1.7)	1.2 (1.1-1.4)	1.8 (1.5-2.1)	1.9 (1.5-2.2)	2.1 (1.7-2.5)	1.5 (1.1-2.0)	1.7 (1.3-2.0)	1.9 (1.4-2.3)	1.4 (1.0-1.7)	.06	0.40 (0.00 to 0.79)
Pancakes, waffles and French toasts	0.8 (0.6-0.9)	0.8 (0.6-1.0)	0.9 (0.7-1.2)	1.1 (0.8-1.4)	1.1 (0.9-1.3)	1.2 (1.0-1.5)	1.0 (0.8-1.2)	1.1 (0.8-1.3)	1.1 (0.9-1.3)	1.3 (1.0-1.6)	.005	0.52 (0.16 to 0.87)
Ready-to-eat/heat mixed dishes												
Ready-to-eat/heat pizza	0.04 (0.00-0.08)	0.03 (0.00-0.10)	1.5 (1.0-2.1)	2.0 (1.2-2.8)	5.2 (4.4-6.1)	5.1 (4.1-6.2)	5.5 (4.5-6.6)	5.7 (4.7-6.6)	6.0 (5.1-6.8)	5.2 (4.5-5.8)	.03	5.13 (4.48 to 5.78)
Ready-to-eat/heat sandwiches and burgers	0.07 (0.03-0.11)	0.07 (0.00-0.1)	0.1 (0.0-0.1)	1.4 (1.1-1.7)	1.0 (0.8-1.3)	1.6 (1.2-1.9)	1.9 (1.4-2.3)	2.6 (1.8-3.3)	2.5 (2.2-2.8)	1.5 (1.2-1.9)	.09	1.48 (1.14 to 1.83)
Other ready-to-eat/heat mixed dishes	2.1 (1.7-2.5)	1.6 (1.3-1.8)	3.0 (2.6-3.3)	2.9 (2.3-3.4)	3.2 (2.5-3.8)	4.7 (3.7-5.6)	3.8 (2.8-4.8)	3.4 (3.2-3.7)	4.1 (3.6-4.7)	4.4 (3.8-5.1)	.001	2.33 (1.59 to 3.07)
Snacks and sweets												
Sweet bakery products	4.4 (3.9-4.9)	5.1 (4.6-5.6)	4.4 (3.8-4.9)	5.0 (4.4-5.5)	4.8 (4.3-5.2)	4.7 (4.2-5.3)	6.1 (5.6-6.6)	5.7 (5.1-6.4)	6.3 (5.5-7.1)	6.7 (5.9-7.4)	.004	2.27 (1.38 to 3.15)
Ice cream and other disserts	3.3 (2.8-3.9)	3.4 (2.9-3.8)	3.1 (2.7-3.6)	3.6 (2.9-4.2)	3.3 (2.8-3.7)	3.2 (2.8-3.5)	2.8 (2.4-3.3)	2.8 (2.5-3.1)	2.8 (2.3-3.4)	3.1 (2.5-3.7)	.009	-0.25 (-1.08 to 0.57)
Candies	2.6 (2.3-2.8)	2.8 (2.6-3.1)	2.7 (2.3-3.1)	2.8 (2.5-3.2)	3.0 (2.7-3.2)	2.6 (2.3-3)	2.4 (2-2.9)	2.8 (2.3-3.2)	2.8 (2.3-3.3)	2.4 (2.1-2.7)	.35	-0.17 (-0.58 to 0.23)
Cereal and nutrition bars	0.3 (0.2-0.4)	0.4 (0.2-0.5)	0.4 (0.2-0.5)	0.4 (0.3-0.5)	0.4 (0.3-0.5)	0.4 (0.3-0.5)	0.6 (0.4-0.9)	0.7 (0.6-0.9)	0.7 (0.5-0.9)	0.7 (0.5-10)	.001	0.42 (0.15 to 0.69)
Sugar-sweetened beverages												

	Estimated Mean (95% CI) of Percent of Energy (%) Consumed from Ultra-Processed Food Subgroup										P-trend	Difference, 2017-2018 vs. 1999-2000
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018		
	(n=3833)	(n=4288)	(n=3824)	(n=4029)	(n=3109)	(n=3280)	(n=3132)	(n=3020)	(n=2900)	(n=2380)		Mean (95% CI)
Soft drinks	7.0 (6.3-7.7)	6.2 (5.7-6.8)	6.2 (5.6-6.8)	5.1 (4.4-5.8)	4.5 (3.8-5.2)	4.0 (3.3-4.6)	3.4 (3-3.8)	3.3 (2.8-3.8)	2.8 (2.5-3.1)	2.7 (2.3-3.2)	<.000	-4.25 (-5.07 to -3.44)
Fruit drinks and other sweetened drinks	3.8 (3.4-4.2)	3.8 (3.4-4.1)	3.9 (3.6-4.3)	4.0 (3.6-4.4)	3.8 (3.5-4.0)	4.0 (3.6-4.4)	4.3 (4-4.6)	3 (2.6-3.4)	2.4 (2.2-2.7)	2.6 (2.3-2.9)	.01	-1.24 (-1.72 to -0.76)
Flavored dairy foods and dairy substitutes												
Flavored milk	1.3 (0.8-1.7)	1.3 (1.0-1.5)	1.4 (1.0-1.8)	1.1 (1-1.3)	1.5 (1.2-1.9)	1.6 (1.3-2)	1.5 (1.1-1.9)	1.5 (1.2-1.8)	1.4 (1.1-1.7)	1.2 (0.9-1.5)	.35	-0.06 (-0.6 to 0.49)
Flavored yogurts	0.2 (0.1-0.3)	0.5 (0.3-0.6)	0.4 (0.3-0.5)	0.6 (0.4-0.7)	0.4 (0.3-0.5)	0.6 (0.5-0.8)	0.6 (0.5-0.8)	0.7 (0.5-0.9)	0.5 (0.4-0.6)	0.6 (0.5-0.8)	.02	0.39 (0.21 to 0.57)
Dairy drinks and dairy substitutes	0.5 (0.4-0.6)	0.7 (0.6-0.9)	0.6 (0.4-0.7)	0.7 (0.5-1)	0.8 (0.6-1)	1.0 (0.8-1.2)	0.8 (0.6-1.0)	0.7 (0.4-1)	0.5 (0.4-0.6)	0.8 (0.5-1.1)	.68	0.27 (-0.04 to 0.58)

Abbreviation: NHANES, National Health and Nutrition Examination Survey; 95% CI, 95% confidence intervals.

eTable 5. Trends in Percent of Energy (%) Consumed from Ultra-Processed Foods Among US Children Aged 2-19 Years by Population Subgroups, 1999-2018

	Estimated Mean (95% CI) of Percent of Energy (%) from Ultra-Processed Foods										*P*-trend [a]	Difference, 1999-2000 versus 2017-2018
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018		
	(n=3833)	(n=4288)	(n=3824)	(n=4029)	(n=3109)	(n=3280)	(n=3132)	(n=3020)	(n=2900)	(n=2380)		Mean (95% CI)
Age group, years												
2-5	56.8 (53.4-60.3)	57.5 (55.9-59.1)	58.5 (55.9-61)	58.8 (56.6-61.0)	59.2 (56.7-61.7)	58.5 (56.1-60.9)	60.2 (57.5-63)	61.2 (59.0-63.5)	60.0 (58.5-61.4)	61.1 (58.9-63.3)	<.001	4.27 (0.27 to 8.28)
6-11	64.6 (61.4-67.8)	62.3 (60.4-64.2)	65.3 (63.9-66.6)	65.3 (63.1-67.6)	67.2 (65.9-68.6)	68 (66.1-69.8)	68.7 (66.5-70.9)	68.2 (66.1-70.3)	67.2 (65.3-69.2)	69 (67.6-70.5)	.002	4.42 (0.99 to 7.84)
12-19	60.8 (58.4-63.3)	62.4 (60.8-63.9)	63.1 (61.7-64.6)	62.4 (60.2-64.7)	65.4 (63.2-67.6)	65.6 (63.4-67.8)	67.7 (65.3-70.2)	64.8 (63.2-66.4)	66.1 (63.8-68.3)	67.7 (65.8-69.7)	<.001	6.89 (3.83 to 9.94)
											P-interaction=.34	*P*-interaction=.17
Sex												
Boys	61.7 (59.6-63.8)	61.3 (59.8-62.9)	63.0 (61.7-64.2)	62.3 (60.6-64)	64.8 (63-66.6)	65.1 (63.1-67.2)	67.0 (64.8-69.2)	64.7 (63.3-66.0)	66.3 (64.7-68)	68.0 (66.0-70.0)	<.001	6.29 (3.46 to 9.13)
Girls	61.1 (59.5-62.7)	61.7 (60.6-62.8)	63.1 (61.4-64.8)	63.3 (61.4-65.2)	65.0 (62.9-67.1)	65.1 (63.2-67.0)	66.4 (64.7-68.1)	66.4 (64.9-68.0)	64.4 (62.5-66.2)	65.8 (64.6-67.0)	<.001	4.71 (2.75 to 6.66)
											P-interaction=.44	*P*-interaction=.26
Race/ethnicity												
Non-Hispanic White	63.4 (61.3-65.4)	62.8 (61.3-64.2)	64.4 (63.2-65.6)	63.6 (61.5-65.7)	66.6 (64.2-69.0)	66.9 (65.1-68.8)	68.1 (65.3-70.9)	66.5 (64.8-68.3)	66.7 (64.8-68.6)	68.6 (66.2-71.0)	<.001	5.21 (2.13 to 8.29)
Non-Hispanic Black	62.2 (59.5-64.9)	63.3 (60.9-65.7)	63.8 (62-65.6)	64.2 (62.6-65.8)	68.2 (65.8-70.5)	67.2 (64.0-70.4)	71.2 (68.4-73.9)	69.4 (67.5-71.3)	67.8 (65.8-69.9)	72.5 (70.2-74.8)	<.001	10.3 (6.84 to 13.8)
Mexican American	55.8 (53.7-58.0)	57.3 (55.5-59.2)	58.8 (56.9-60.7)	57.7 (56.2-59.3)	60.8 (58.5-63.1)	61.4 (59.7-63.2)	63.4 (60.7-66.0)	62.7 (61.4-64.1)	63.8 (62.0-65.6)	63.5 (61.0-66.0)	<.0001	7.64 (4.37 to 10.9)
											P-interaction=.04	*P*-interaction=.05
Head of household education												
< High school	62.4 (56.4-68.3)	61.3 (59.7-63.0)	61.5 (59.2-63.9)	60.3 (58.2-62.4)	64.4 (62-66.8)	65.0 (62.6-67.4)	68.3 (65.8-70.8)	64.3 (61.8-66.7)	63.4 (60.2-66.6)	63.9 (61.3-66.6)	.054	1.55 (-4.83 to 7.94)

	Estimated Mean (95% CI) of Percent of Energy (%) from Ultra-Processed Foods										P-trend [a]	Difference, 1999-2000 versus 2017-2018
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018		
	(n=3833)	(n=4288)	(n=3824)	(n=4029)	(n=3109)	(n=3280)	(n=3132)	(n=3020)	(n=2900)	(n=2380)		Mean (95% CI)
High school or some college	61.7 (59.2-64.3)	62.1 (60-64.1)	63.4 (62.1-64.7)	63.4 (61.8-64.9)	66.8 (65.6-68.1)	65.5 (63.8-67.3)	67.2 (65.1-69.2)	66.1 (64.6-67.6)	67.1 (65.7-68.5)	69.5 (67.9-71.0)	<.001	7.74 (4.85 to 10.6)
College graduate	61 (58.7-63.4)	60.3 (58.1-62.5)	62.8 (60.5-65.1)	62.9 (59.5-66.2)	60.5 (56.2-64.9)	64.4 (60.7-68.2)	64.3 (61.2-67.4)	65.2 (62.2-68.2)	64.4 (62.0-66.7)	64.4 (61.5-67.3)	.001	3.36 (-0.29 to 7.02)
											P-interaction=.31	P-interaction=.11
Ratio of family income to poverty level [b]												
<1.30	61.2 (58.7-63.8)	60.3 (58.1-62.5)	62.2 (59.8-64.7)	61 (59.2-62.9)	65.2 (62.1-68.4)	65.8 (63.8-67.8)	67.7 (65.6-69.8)	65 (63.3-66.7)	66 (63.9-68.2)	67.9 (65.8-69.9)	<.001	6.61 (3.43 to 9.80)
1.30-2.99	62.6 (59.5-65.6)	62.1 (60.5-63.8)	63.7 (61.1-66.3)	63.1 (61.3-65)	65.6 (63.9-67.3)	64.7 (62.5-67.0)	66.3 (63.3-69.2)	65 (62.1-68.0)	64.8 (63.1-66.5)	67.8 (66.3-69.3)	<.001	5.22 (1.91 to 8.52)
≥3.00	62.5 (60.3-64.6)	62.6 (61.2-64.0)	63.7 (62.3-65.2)	63.9 (61.6-66.1)	64.5 (62.0-67.0)	66.3 (62.3-70.4)	65.9 (63.6-68.3)	66.3 (64.5-68.0)	66.2 (64.0-68.4)	66.7 (64.0-69.3)	<.001	4.18 (0.83 to 7.54)
											P-interaction=.16	P-interaction=.28

Abbreviation: NHANES, National Health and Nutrition Examination Survey; 95% CI, 95% confidence intervals.

[a] *P* for trend was estimated by treating survey-cycle as a continuous variable (1-10) in a survey-weighted linear regression model. *P*-for interaction in trend and change was calculated using survey-weighted Wald F test for an interaction term between the continuous survey-cycle and sociodemographic characteristics.

[b] Ratio of family income to poverty level represents the ratio of family income to the federal poverty threshold in a particular year (e.g., for family of four, the threshold was $17050 in 2000 and $24600 in 2017). A higher ratio corresponds to a higher level of income.

eTable 6. Nutrient Profiles of Commonly Consumed Ultra-Processed Foods Among US Children 2-19 years, NHANES 2017-2018[a]

	Ultra-Processed Food Subgroups,[b] Mean (95%CI)					
	Industrial grain foods	**Ready-to-eat/heat mixed dishes**	**Sweet snacks and sweets**	**Savory snacks**	**Fast food or reconstituted meat/poultry/fish**	**Sugar-sweetened beverages**
Carbohydrates, %E	70.0 (69.1-70.9)	46.8 (45.8-47.8)	58.5 (57.5-59.6)	50.2 (48.2-52.3)	12.2 (10.8-13.5)	94.3 (92.1-96.4)
Protein, %E	11.3 (10.9-11.6)	16.2 (15.7-16.7)	4.8 (4.7-5.0)	6.5 (6.2-6.8)	26.5 (25.4-27.5)	2.9 (0.9-5.0)
Total fats, %E	18.7 (17.7-19.8)	37.0 (36.1-37.9)	36.6 (35.6-37.6)	43.3 (41.0-45.6)	61.4 (59.6-63.2)	2.8 (2.2-3.3)
Saturated fats, %E	5.8 (5.4-6.2)	14.1 (13.4-14.7)	15.9 (14.9-16.8)	8.65 (7.9-9.41)	18.1 (16.7-19.5)	0.22 (0.12-0.33)
Monounsaturated fats, %E	5.2 (4.8-5.5)	12.2 (11.8-12.7)	11.7 (11.1-12.3)	14.7 (13.6-15.8)	24.3 (23.2-25.3)	0.46 (0.17-0.74)
Polyunsaturated fats, %E	5.6 (5.3-5.9)	7.5 (7.2-7.8)	6.4 (5.9-6.9)	16.8 (16.1-17.6)	12.7 (11.6-13.7)	0.38 (0.25-0.51)
Added sugar, %E	11.4 (10.6-12.2)	2.1 (1.9-2.4)	32.3 (31.3-33.3)	1.17 (0.69-1.65)	0.89 (0.58-1.2)	81.4 (79.2-83.6)
Fiber, g/100 kcal	1.16 (1.12-1.19)	0.88 (0.85-0.91)	0.48 (0.45-0.51)	0.84 (0.80-0.88)	0.20 (0.18-0.23)	0.08 (0.05-0.12)
Sodium, mg/100 kcal	166 (161-170)	248 (243-253)	61.6 (57.9-65.2)	147 (142-152)	274 (254-293)	40.9 (36.7-45.1)
Calcium, mg/100 kcal	48.9 (46.7-51.1)	48.6 (46.1-51.0)	20.2 (18.1-22.2)	15.7 (14.8-16.7)	9.6 (8.7-10.5)	16.8 (13.3-20.3)
Magnesium, mg/100 kcal	11.6 (11.3-12)	10.1 (9.7-10.6)	7.7 (7.2-8.1)	10.9 (10.4-11.4)	8.2 (7.9-8.6)	8.3 (6.8-9.8)
Potassium, mg/100 kcal	50.3 (48.9-51.7)	88.7 (85.7-91.7)	50.4 (47.8-53.1)	81.9 (75.1-88.7)	121 (116.6-125.3)	58.4 (48.2-68.6)
Iron, mg/100 Kcal	1.8 (1.7-2.0)	0.78 (0.76-0.8)	0.56 (0.51-0.61)	0.52 (0.48-0.57)	0.46 (0.43-0.49)	0.26 (0.20-0.32)
Zinc, mg/100 Kcal	0.66 (0.6-0.71)	0.46 (0.44-0.48)	0.2 (0.19-0.22)	0.24 (0.23-0.25)	0.68 (0.61-0.76)	0.23 (0.17-0.28)
Vitamin A, µg/100 kcal	37.2 (32.7-41.7)	19.3 (18.0-20.5)	20.0 (16.4-23.7)	1.9 (1.6-2.2)	3.5 (2.8-4.1)	10.7 (6.8-14.6)
Vitamin C, mg/100 kcal	1.2 (1.0-1.4)	0.65 (0.42-0.88)	1.3 (1.0-1.6)	1.7 (1.4-2.0)	0.32 (0.23-0.41)	10.7 (8.4-13.0)

	Ultra-Processed Food Subgroups,[b] Mean (95%CI)					
	Industrial grain foods	Ready-to-eat/heat mixed dishes	Sweet snacks and sweets	Savory snacks	Fast food or reconstituted meat/poultry/fish	Sugar-sweetened beverages
Vitamin D, µg/100 kcal	0.20 (0.17-0.22)	0.03 (0.02-0.04)	0.03 (0.02-0.03)	0.00 (0.00-0.00)	0.15 (0.14-0.16)	0.06 (0.00-0.11)
Vitamin E, µg/100 kcal	0.22 (0.18-0.27)	0.35 (0.32-0.38)	0.33 (0.3-0.36)	0.79 (0.72-0.85)	0.39 (0.36-0.42)	0.31 (0.18-0.45)
Folate, DFE, µg/100 kcal[c]	75.8 (71.5-80.1)	37.5 (35.8-39.2)	13.7 (12.0-15.4)	19.2 (16.2-22.2)	6.3 (5.7-6.9)	4.9 (2.8-7.0)
Food folate, µg/100 kcal[d]	9.9 (9.2-10.7)	9.4 (8.9-9.9)	3.9 (3.6-4.1)	5.4 (5.0-5.7)	4.2 (3.7-4.6)	1.2 (0.7-1.7)
Folic acid, µg/100 kcal[e]	39.1 (36.4-41.9)	16.5 (15.6-17.4)	5.8 (4.8-6.8)	8.2 (6.5-9.8)	1.2 (0.9-1.5)	2.2 (0.9-3.4)

Abbreviation: DFE, dietary folate equivalent (DFE); NHANES, National Health and Nutrition Examination Survey; UPF, ultra-processed foods; %E, percent of total energy intake.

[a.] Nutrient profiles were assessed by percent of energy for major macronutrients, and the mean intake levels of fiber, sodium, vitamins (A, C, and D) and minerals (calcium, magnesium, and potassium) per 100 kcal of calories consumed from ultra-processed foods.

[b.] For ultra-processed foods subgroups, industrial grains included breads/rolls/tortillas, biscuits/muffins/quick breads, pancakes/waffles/French toasts, and breakfast cereals; ready-to-eat/heat mixed dishes included ready-to-eat/heat pizza, ready-to-eat/heat sandwich and hamburgers, and other ready-to-eat/heat mixed dishes; sweet snacks and sweets included sweet bakery products, candies, cereal and nutrition bars, ice creams, ice pops, frozen yogurts, and other disserts such as pudding and fruit desserts; savory snacks included crackers, chips, and popcorn; sweet bakery products included cakes, cookies, pies and pastries; fast food or reconstituted meat/poultry/fish included fast food meat patties or fish sticks, chicken nuggets, sausages, hams, lunchmeats, meat spreads, meat jerky; sugar sweetened beverages included carbonated soft drinks, fruit drink, energy drinks, sports drinks

[c] Total folate included folate from both natural food sources and those from fortified food sources. The amount of total folate was assessed in Dietary Folate Equivalents, calculate as food folate + folic acid×1.667.

[d] Food folate included folate from natural food sources (e.g., vegetables, fruits, nuts, beans, sea food, eggs, and dairy).

[e] Folic acid is the synthetic form added to foods (e.g., flour, breads, cereals, and pastas) for fortification purposes.

eTable 7. Nutrient Intake Across Quintiles of Percent of Energy Intake (%) from Ultra-Processed Foods Among US Children Aged 2-19 years, NHANES 2017-2018

Nutrients	Total	Quintiles of Percent of Energy Intake from Ultra-processed Foods[a]					P value [b]
		Q1	Q2	Q3	Q4	Q5	
		Survey Weighted Mean (95% CI)					
Carbohydrate, %E	50.9 (50.3-51.5)	49 (47.7-50.4)	50.8 (49.9-51.8)	50.5 (49.3-51.6)	51.4 (50.4-52.4)	52.5 (51.5-53.4)	<.001
Protein, %E	13.9 (13.5-14.4)	17.1 (16.2-18)	14.8 (14.0-15.7)	13.7 (13.3-14.2)	12.9 (12.3-13.6)	11.5 (11.1-11.8)	<.001
Total fat, %E	35.2 (34.7-35.6)	33.9 (33-34.8)	34.3 (33.3-35.4)	35.8 (34.8-36.8)	35.7 (35.1-36.2)	36.1 (35.2-36.9)	.001
Saturated fat, %E	12.1 (11.9-12.3)	11.4 (10.9-11.9)	12.0 (11.2-12.9)	12.5 (12.3-12.8)	12.2 (11.9-12.6)	12.3 (11.9-12.8)	.19
Monounsaturated fats, %E	11.5 (11.4-11.7)	11.3 (10.8-11.8)	11.3 (10.9-11.6)	11.6 (11.1-12.1)	11.6 (11.3-11.8)	12.0 (11.5-12.5)	.05
Polyunsaturated fats, %E	8.0 (7.8-8.2)	7.57 (7.0-8.2)	7.6 (7.3-7.9)	8.1 (7.7-8.5)	8.4 (8.0-8.7)	8.4 (7.9-8.9)	.001
Added sugar, %E	14.5 (13.9-15.1)	9.41 (8.58-10.24)	12.2 (11-13.4)	14.6 (13.8-15.3)	16.2 (15-17.4)	20.1 (18.5-21.6)	<.001
Fiber, g per 1000 kcal/day	7.4 (7.1-7.6)	8.8 (8.2-9.4)	7.8 (7.4-8.2)	7.2 (6.8-7.6)	7.1 (6.5-7.7)	5.9 (5.7-6.2)	<.001
Sodium, mg per 1000 kcal/day	1530 (1500-1570)	1570 (1490-1650)	1520 (1470-1570)	1520 (1440-1600)	1520 (1460-1570)	1550 (1490-1610)	.71
Calcium, mg per 1000 kcal/day	508 (494-523)	545 (499-590)	537 (500-573)	532 (499-565)	499 (479-519)	420 (396-445)	<.001
Magnesium, mg per 1000 kcal/day	122 (119-126)	146 (139-153)	131 (126-136)	123 (118-128)	115 (110-120)	98 (94-101)	<.001
Potassium, mg per 1000 kcal/day	1100 (1070-1130)	1330 (1270-1400)	1200 (1150-1250)	1090 (1060-1130)	1010 (970-1040)	878 (855-900)	<.001
Iron, mg per 1000 kcal/day	6.9 (6.7-7.1)	6.8 (6.5-7.2)	7.0 (6.7-7.4)	7.0 (6.6-7.3)	7.0 (6.7-7.4)	6.6 (6.2-7.0)	.88
Zinc, mg per 1000 kcal/day	4.9 (4.8-5.1)	5.6 (5.4-5.8)	5.1 (4.8-5.5)	5.0 (4.5-5.4)	4.8 (4.5-5.1)	4.1 (3.8-4.4)	<.001
Vitamin A, µg per 1000 Kcal/day	307 (291-324)	341 (309-373)	338 (310-366)	329 (301-356)	300 (284-317)	219 (188-250)	<.001
Vitamin C, mg per 1000 Kcal/day	38 (35-41)	46 (41-52)	51 (42-60)	36 (32-40)	31 (27-35)	25 (22-29)	<.001
Vitamin D, µg per 1000 Kcal/day	2.5 (2.3-2.6)	3.1 (2.8-3.4)	2.7 (2.4-3.0)	2.6 (2.3-2.8)	2.3 (2.1-2.5)	1.6 (1.3-1.9)	.85
Vitamin E, mg per 1000 Kcal/day	4.0 (3.8-4.2)	4.1 (3.6-4.6)	3.8 (3.7-4.0)	4.0 (3.8-4.2)	4.1 (3.5-4.7)	4.0 (3.5-4.6)	<.001
Total folate, DFE, µg per 1000 kcal/day [c]	254 (246-262)	264 (248-280)	259 (248-270)	253 (238-269)	253 (234-272)	240 (223-257)	.07
Food folate, µg per 1000 kcal/day [d]	78 (75-81)	98 (91-106)	84 (78-90)	75 (71-78)	72 (68-77)	64 (60-68)	<.001
Folic acid, µg per 1000 kcal/day [e]	104 (99-109)	98 (90-106)	103 (95-111)	106 (96-116)	107 (97-117)	104 (93-115)	.37

Abbreviation: DFE, Dietary Folate Equivalents; NHANES, National Health and Nutrition Examination Survey; 95% CI, 95% confidence intervals; Q, quintile

ª Median (range): Q1: 40.7% (0.91%-48.6%), Q2=55.9% (48.6%-62.4%), Q3=68.3% (62.4%-73.9%), Q4=79.4% (73.9%-85.3%), Q5=92.9% (85.3%-100%).

ᵇ *P* value assessed the linear trend of mean nutrient intake across quintiles of ultra-processed food consumption.

ᶜ Total folate included folate from both natural food sources and those from fortified food sources. The amount of total folate was assessed in Dietary Folate Equivalents, calculate as food folate + folic acid×1.667.

ᵈ Food folate included folate from natural food sources (e.g., vegetables, fruits, nuts, beans, sea food, eggs, and dairy).
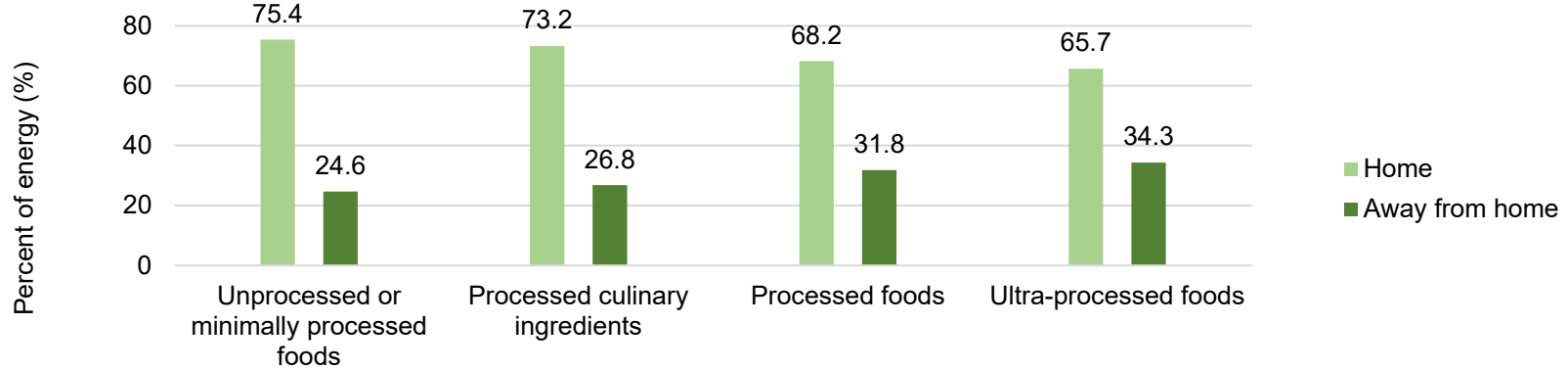
ᵉ Folic acid is the synthetic form added to foods (e.g., flour, breads, cereals, and pastas) for fortification purposes.

eFigure. Estimated Percent of Energy Intake from NOVA Food Groups by Food Source and Eating Location Among US Children and Adolescents, NHANES 2017-2018

A. By Food Source
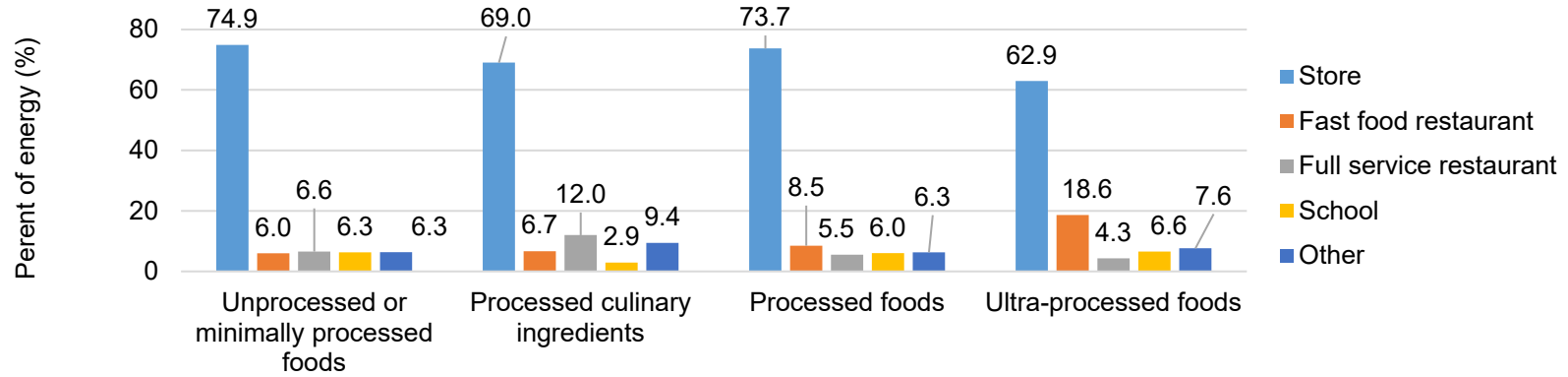
B. By Eating Location

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