

Supplementary Online Content

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

eAppendix. Details and Examples of the NOVA Classification

All food and beverage items of the NutriNet-Santé composition table were categorized by a team of three trained dietitians into one of the four food groups in NOVA, a food classification system based on the extent and purpose of industrial food processing¹. The whole classification was then reviewed by a committee composed of the three dietitians and five researchers, specialists in nutritional epidemiology. In case of uncertainty for a given food/beverage item, a consensus was reached among researchers based on the percentage of home-made and artisanal foods versus industrial brands reported by the participants. We focused this study on the “ultra-processed foods” group of the NOVA classification. Examples of such products as well as examples of distinctions between ultra-processed products and products from other NOVA categories are provided below.

The other NOVA food groups are the following:

Group 1: “unprocessed or minimally processed foods”, which are foods obtained directly from plants or animals, such as fresh fruits and vegetables, eggs, milk; or foods that have undergone some processes such as cleaning, sorting, splitting, grinding, drying, fermenting, pasteurizing, cooling, freezing and other processing, without adding any other substances: grains, legumes, meat, poultry, fish and seafood, fruit or vegetable juices without added sugar, sweeteners or flavors, nuts without added salt or sugar, spices and herbs, plain yoghurt with no added sugar or artificial sweeteners, plain tea and coffee).

Group 2: “processed culinary ingredients”, which are substances derived from unprocessed foods, such as oils, butter, sugar and salt, not meant to be consumed by themselves but used in combination with unprocessed or minimally processed foods in culinary preparations.

Group 3: “processed foods”, such as canned vegetables or canned fish with added salt, fruits in syrup, cheeses and freshly made breads, and other manufactured food products made by adding salt, oil, sugar or other culinary ingredients to unprocessed or minimally processed foods.

Examples of ultra-processed food according to the NOVA classification include:

Carbonated drinks; sweet or savory packaged snacks; ice cream, chocolate, candies (confectionery); mass-produced packaged breads and buns; margarines and spreads; industrial cookies (biscuits), pastries, cakes, and cake mixes; breakfast ‘cereals’, ‘cereal’ and ‘energy’ bars; ‘energy’ drinks; flavored milk drinks; cocoa drinks; sweet desserts made from fruit with added sugars, artificial flavors and texturizing agents; cooked seasoned vegetables with ready-made sauces; meat and chicken extracts and ‘instant’ sauces; ‘health’ and

'slimming' products such as powdered or 'fortified' meal and dish substitutes; ready to heat products including pre-prepared pies, pasta and pizza dishes; poultry and fish 'nuggets' and 'sticks', sausages, burgers, hot dogs, and other reconstituted meat products, and powdered and packaged 'instant' soups, noodles and desserts.

To be included in the UPF group food products are required to have specific characteristics. UPF are made primarily from food-derived substances to which additives are added. The ingredients of these formulations generally include those also used in processed foods (such as sugars, oils, fats or salt), but UPF also include other sources of energy and nutrients that are not used in domestic cooking. Some of them are directly extracted from foods such as casein, lactose, whey and gluten. Many come from the subsequent processing of food components, such as hydrogenated oils, hydrolyzed proteins, soy protein isolates, maltodextrin, invert sugar and high fructose corn syrup. Categories of additives found only in ultra-processed products include dyes, flavorings, flavor enhancers, artificial sweeteners, and processing aids such as thickeners, bulking agents, anti-foaming agents, anti-caking agents, emulsifiers, sequestering agents and humectants. A multitude of processes are used to transform and combine the many ingredients and create the final product. The methods include several non-domestic equivalent processes, such as the hydrogenation of oils or the extrusion of cereals. For instance, fresh or pasteurized fruit juices are in group 1 only if they do not contain added sugar. Fruit juices that contain sugar are classified as "processed". Fruit drinks containing additives (colors, flavors, artificial sweeteners ...) will be classified as "ultra-processed". Cheese that are made without the addition of additives, flavors, colors, etc. are classified as "processed" foods. On the other hand, industrial cheese or spreadable cheese which contain other ingredients than milk, cream and salt, are ultra-processed.

Natural unsweetened yogurts, which do not contain any additives, are in Group 1 of minimally processed foods. Yogurts containing sugar or other ingredients than milk and lactic ferments, such as flavors, colors, sweeteners, thickeners, or other additives, are ultra-processed.

As for breakfast cereals, cereal flakes, grits, steel-cut, rolled or instant oats, are in group 1 if they do not contain any sugar, salt, oil or additives. Mueslis without added sugar/salt/oils and containing only flakes and dried fruits or nuts are classified as processed. Only sweetened breakfast cereals that have undergone processes like extrusion of wheat or corn are ultra-processed.

Fruit compotes with only added sugar are considered as “processed foods”, while flavored fruit desserts with added sugar, texturizing agents and colorants are considered as “ultra-processed foods”.

Regarding meats, salted-only red or white meats are considered as “processed foods” whereas smoked or cured meats with added nitrites and conservatives, such as sausages and ham are classified as “ultra-processed foods”.

Similarly, canned salted vegetables are considered as “processed foods” whereas industrial cooked or fried seasoned vegetables, marinated in industrial sauces with added flavorings are considered as “ultra-processed foods”.

Example of a list of ingredients for an industrial Chicken and Leek flavor soup considered as “ultra-processed” according to the NOVA classification: “*Dried Glucose Syrup, Potato Starch, Flavorings, Salt, Leek Powder (3.6%), Dried Leek (3.5%), Onion Powder, Dried Carrot, Palm Oil, Dried Chicken (0.7%), Garlic Powder, Dried Parsley, Color [Curcumin (contains MILK)], Ground Black Pepper, MILK Protein, Stabilizers (Dipotassium Phosphate, Trisodium Citrate)*”.

eTable 12. Sociodemographic and Lifestyle Characteristics of the Study Population According to Quartiles of Proportion of Ultra-processed Food in the Diet (n = 44,551)

		Proportion of ultra-processed food in the diet (in weight)				
		Quartile 1	Quartile 2	Quartile 3	Quartile 4	
		<9.3%	9.3-13.2%	13.2-18.0%	>18.0%	
		N (%)	N (%)	N (%)	N (%)	P-trend ^a
		11137 (25.0)	11138 (25.0)	11138 (25.0)	11138 (25.0)	
Age (years)	Mean (SD)	57.04 (7.37)	56.77 (7.45)	56.71 (7.64)	56.23 (7.68)	<0.0001
Sex	Men	2727 (24.5)	2975 (26.7)	3039 (27.3)	3261 (29.3)	<0.0001
(n = 44551)	Women	8410 (75.5)	8163 (73.3)	8099 (72.7)	7877 (70.7)	
Income per household unit (€/month)	<1200	1082 (11.0)	1060 (10.6)	1192 (11.9)	1460 (14.7)	<0.0001
	1200-1799	2240 (22.7)	2401 (24.1)	2513 (25.2)	2598 (26.2)	
	1800-2299	1589 (16.1)	1633 (16.4)	1630 (16.3)	1728 (17.4)	
(n = 39744)	≥2300	4954 (50.2)	4876 (48.9)	4642 (46.5)	4146 (41.7)	
Marital status	Single/divorced/widowed	2749 (24.7)	2653 (23.8)	2712 (24.4)	3161 (28.4)	<0.0001
(n = 44521)	Married/cohabiting	8381 (75.3)	8481 (76.2)	8417 (75.6)	7967 (71.6)	
Educational level	No diploma or primary school	471 (4.3)	476 (4.3)	559 (5.1)	635 (5.7)	<0.0001
	Secondary school	4145 (37.6)	4364 (39.6)	4553 (41.2)	4926 (44.6)	
	Graduate studies ≤ 3 years	3272 (29.7)	3197 (29)	3105 (28.1)	2953 (26.7)	
	Graduate studies > 3 years	3134 (28.4)	2997 (27.2)	2831 (25.6)	2540 (23)	
Residence	Rural	2325 (21.2)	2403 (21.9)	2596 (23.6)	2587 (23.7)	<0.0001
(n = 43898)	UU <20,000 inhabitants	1693 (15.4)	1813 (16.5)	1782 (16.2)	1773 (16.2)	
	UU 20,000-200,000 inhabitants	2085 (19)	2074 (18.9)	2127 (19.3)	2111 (19.3)	
	UU >200,000 inhabitants	4877 (44.4)	4701 (42.8)	4488 (40.8)	4463 (40.8)	
Smoking status	Never smoked	4704 (42.3)	4848 (43.5)	4998 (44.9)	5020 (45.1)	0.008
(n = 44529)	Former smoker	5157 (46.3)	5064 (45.5)	4905 (44.1)	4754 (42.7)	
	Current smoker	1270 (11.4)	1222 (11)	1231 (11.1)	1356 (12.2)	
BMI (kg/m ²)	Mean (SD)	24.15 (4.28)	24.41 (4.32)	24.53 (4.28)	25.10 (4.85)	<0.0001
(n = 44415)						
IPAQ	Low	1597 (16.4)	1924 (19.5)	2084 (21.2)	2348 (24.1)	<0.0001

(n = 39168)	Moderate	3753 (38.5)	3956 (40.1)	3840 (39.1)	3799 (39)	
	High	4402 (45.1)	3976 (40.3)	3896 (39.7)	3593 (36.9)	
1 st degree family history of cancer	No	5284 (47.6)	5328 (48)	5307 (47.8)	5355 (48.3)	0.4
(n = 44387)	Yes	5809 (52.4)	5772 (52)	5800 (52.2)	5732 (51.7)	
1 st degree family history of CVDs	No	6980 (62.9)	7115 (64.1)	7013 (63.1)	7087 (63.9)	0.3
(n = 44387)	Yes	4113 (37.1)	3985 (35.9)	4094 (36.9)	4000 (36.1)	

Abbreviations: SD, standard deviation; UU, urban unit; CVDs, cardiovascular diseases.

^aP-values for trend are obtained with Chi-square tests for trend (Cochran-Armitage test for categorical variables with 2 levels, Cochran-Mantel-Haenszel test for categorical variables with ≥ 3 levels) or linear regression with linear contrast according to the categorical or continuous nature of the variable.

Table 13. Means of Proportion of Ultra-processed Food in the Diet of Adults From the Study Population (n = 44,551)

		Proportion of ultra-processed food in the diet (in % total energy intake)		
		Mean	SE	P-value ^a
Age (years)	45-64	29.59	0.06	<0.0001
	≥ 65	26.28	0.13	
Sex (n = 44551)	Men	28.26	0.10	<0.0001
	Women	29.40	0.06	
Income per household unit (€/month) (n = 39744)	<1200	31.03	0.16	<0.0001
	1200-1799	29.85	0.11	
	1800-2299	29.32	0.13	
	≥ 2300	28.10	0.08	
Marital status (n = 44521)	Single/divorced/widowed	29.98	0.10	<0.0001
	Married/cohabiting	28.79	0.06	
Educational level (n = 44158)	No diploma or primary school	29.53	0.23	<0.0001
	Secondary school	29.52	0.08	
	Graduate studies ≤ 3 years	29.06	0.10	
	Graduate studies > 3 years	28.40	0.10	
Residence (n = 43898)	Rural	29.07	0.11	0.6
	UU <20,000 inhabitants	28.91	0.13	
	UU 20,000-200,000 inhabitants	29.15	0.12	
	UU >200,000 inhabitants	29.06	0.08	
Smoking status (n = 44529)	Never smoked	28.97	0.08	<0.0001
	Former smoker	28.84	0.08	
	Current smoker	30.57	0.15	
BMI (kg/m ²) (n = 44415)	<18.5	28.35	0.30	<0.0001
	18.5-24.99	28.65	0.07	
	25-29.99	29.30	0.10	
	≥ 30	31.27	0.16	
IPAQ	Low	30.79	0.12	<0.0001

(n = 39168)	Moderate	29.22	0.09	
	High	28.03	0.09	
1 st degree family history of cancer	No	29.22	0.07	0.01
(n = 44387)	Yes	28.96	0.07	0.001
1 st degree family history of CVDs	No	29.21	0.06	
(n = 44387)	Yes	28.87	0.09	

Abbreviations: SE, standard error; UU, urban unit; CVDs, cardiovascular diseases.
^aP-values are obtained with *t* tests or analysis of variance (ANOVA) when appropriate.

eTable 14. Sociodemographic and Lifestyle Characteristics of the Study Population According to Quartiles of the Energy-weighted Proportion of Ultra-processed Food in the Diet (n = 44,551)

		Proportion of ultra-processed food in the diet (in % total energy intake)					
		Quartile 1	Quartile 2	Quartile 3	Quartile 4		
		<21.6%	21.6-28.2%	28.2-35.7%	>35.7%		
		N (%)	N (%)	N (%)	N (%)	P-trend ^a	
		11137 (25.0)	11138 (25.0)	11138 (25.0)	11138 (25.0)	<0.00 01	
Age (years)	Mean (SD)	58.41 (7.55)	57.39 (7.39)	56.34 (7.52)	54.61 (7.18)		
Sex	Men	3299 (29.6)	3086 (27.7)	2902 (26.1)	2715 (24.4)	<0.00 01	
(n = 44551)	Women	7838 (70.4)	8052 (72.3)	8236 (73.9)	8423 (75.6)		
Income per household unit (€/month)	<1200	1027 (10.4)	1051 (10.5)	1212 (12.1)	1504 (15.2)	<0.00 01	
	1200-1799	2208 (22.4)	2369 (23.6)	2475 (24.7)	2700 (27.4)		
	1800-2299	1572 (16.0)	1678 (16.7)	1663 (16.6)	1667 (16.9)		
(n = 39744)	≥2300	5045 (51.2)	4923 (49.1)	4657 (46.5)	3993 (40.5)		
Marital status	Single/divorced/widowed	2762 (24.8)	2618 (23.5)	2688 (24.1)	3207 (28.8)	<0.00 01	
(n = 44521)	Married/cohabiting	8370 (75.2)	8509 (76.5)	8444 (75.9)	7923 (71.2)		
Educational level	No diploma or primary school	518 (4.7)	540 (4.9)	513 (4.6)	570 (5.2)	<0.00 01	
	(n = 44158)	Secondary school	4280 (38.8)	4472 (40.5)	4503 (40.8)		4733 (42.8)
		Graduate studies ≤ 3 years	3121 (28.3)	3146 (28.5)	3140 (28.4)		3120 (28.2)
		Graduate studies > 3 years	3107 (28.2)	2881 (26.1)	2886 (26.1)		2628 (23.8)
Residence	Rural	2436 (22.1)	2447 (22.3)	2613 (23.8)	2415 (22.1)	<0.00 01	
(n = 43898)	UU <20.000 inhabitants	1752 (15.9)	1849 (16.8)	1724 (15.7)	1736 (15.9)		
	UU 20.000-200.000 inhabitants	2073 (18.8)	2181 (19.8)	2071 (18.8)	2072 (19.0)		
	UU >200.000 inhabitants	4747 (43.1)	4516 (41.1)	4579 (41.7)	4687 (43.0)		
Smoking status	Never smoked	4863 (43.7)	4958 (44.5)	4998 (44.9)	4751 (42.7)	<0.00 01	
	Former smoker	5130 (46.1)	5038 (45.3)	4858 (43.6)	4854 (43.6)		
	(n = 44529)	Current smoker	1140 (10.2)	1134 (10.2)	1277 (11.5)		1528 (13.7)
BMI (kg/m ²)	Mean (SD)	24.19 (4.22)	24.41 (4.28)	24.56 (4.34)	25.03 (4.89)	<0.00 01	
(n = 44415)							
IPAQ	Low	1637 (16.7)	1833 (18.6)	2091 (21.3)	2392 (24.6)	<0.00 01	

(n = 39168)	Moderate	3723 (38.0)	3831 (38.9)	3924 (40.0)	3870 (39.8)	
	High	4432 (45.3)	4177 (42.4)	3794 (38.7)	3464 (35.6)	
1 st degree family history of cancer	No	5235 (47.2)	5311 (47.8)	5295 (47.7)	5433 (49.0)	0.01
(n = 44387)	Yes	5859 (52.8)	5794 (52.2)	5804 (52.3)	5656 (51.0)	
1 st degree family history of CVDs	No	6928 (62.4)	7019 (63.2)	7100 (64.0)	7148 (64.5)	0.000 9
(n = 44387)	Yes	4166 (37.6)	4086 (36.8)	3999 (36.0)	3941 (35.5)	

Abbreviations: SD, standard deviation; UU, urban unit; CVDs, cardiovascular diseases.

^aP-values for trend are obtained with Chi-square tests for trend (Cochran-Armitage test for categorical variables with two levels, Cochran-Mantel-Haenszel test for categorical variables with ≥ 3 levels) or linear regression with linear contrast according to the categorical or continuous nature of the variable.

eTable 15. Nutrient Intake According to Quartiles of Proportion of Ultra-processed Food in the Diet of Adults From the Study Population (n = 44,551)

Nutrient	Proportion of ultra-processed food in the diet (in weight)				P-trend ^a
	Quartile 1	Quartile 2	Quartile 3	Quartile 4	
	<9.3%	9.3-13.2%	13.2-18.0%	>18.0%	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
mPNNS-GS	8.72 (1.60)	8.32 (1.64)	8.07 (1.63)	7.73 (1.66)	<0.0001
EI (kcal/d)	1823.40 (432.93)	1903.07 (443.67)	1928.30 (454.86)	1922.16 (476.23)	<0.0001
Carbohydrates (% EI)	40.39 (7.37)	40.79 (6.62)	41.15 (6.41)	41.60 (6.74)	<0.0001
Protein (% EI)	18.11 (4.02)	17.43 (3.31)	17.21 (3.25)	17.12 (3.62)	<0.0001
Lipids (% EI)	37.72 (6.44)	38.06 (5.72)	38.25 (5.66)	38.36 (5.79)	<0.0001
Alcohol (% EI)	3.77 (4.62)	3.72 (4.28)	3.39 (3.99)	2.93 (3.86)	<0.0001
Alcohol (g/d)	10.32 (13.74)	10.67 (13.31)	9.76 (12.33)	8.42 (12.10)	<0.0001
Complex carbohydrates ^b (g/d)	98.98 (38.58)	103.64 (36.67)	105.41 (37.04)	104.31 (37.66)	0.08
Simple carbohydrates (g/d)	84.76 (30.61)	89.57 (29.58)	92.15 (30.02)	94.69 (32.86)	<0.0001
Fibers (g/d)	21.65 (7.47)	21.16 (6.68)	20.98 (6.69)	20.42 (7.10)	<0.0001
SFA (g/d)	29.69 (10.68)	32.30 (10.97)	33.34 (11.32)	33.62 (12.09)	<0.0001
MUFA (g/d)	29.68 (10.27)	30.57 (9.61)	30.82 (9.84)	30.55 (10.15)	<0.0001
n-3 fatty acids (g/d)	1.61 (0.89)	1.56 (0.77)	1.53 (0.76)	1.47 (0.78)	<0.0001
n-6 fatty acids (g/d)	9.13 (4.66)	9.53 (4.20)	9.76 (4.36)	9.93 (4.58)	<0.0001
Cholesterol (g/d)	309.99 (128.99)	323.41 (122.13)	328.71 (126.00)	323.66 (132.49)	0.9
Animal protein (g/d)	55.49 (19.05)	55.94 (18.08)	55.89 (18.05)	55.09 (19.64)	<0.0001
Plant protein (g/d)	25.68 (8.37)	25.89 (7.86)	25.97 (8.05)	25.87 (8.91)	<0.0001
Sodium (mg/d)	2609.31 (862.99)	2798.31 (877.84)	2867.47 (879.10)	2867.59 (931.66)	<0.0001
Potassium (mg/d)	3238.03 (817.25)	3177.29 (760.06)	3141.33 (747.63)	3094.54 (785.02)	<0.0001
Calcium (mg/d)	935.46 (294.04)	935.55 (278.93)	937.40 (279.87)	930.65 (292.13)	<0.0001
Iron (mg/d)	14.15 (4.69)	14.16 (4.57)	14.10 (4.49)	13.91 (4.84)	<0.0001
Beta-carotene (µg/d)	4053.71 (2724.9)	3823.85 (2344.1)	3760.84 (2281.0)	3629.98 (2322.4)	<0.0001
Vitamin B6 (mg/d)	1.79 (0.53)	1.79 (0.51)	1.80 (0.52)	1.80 (0.58)	<0.0001
Vitamin B9 (µg/d)	353.44 (114.08)	346.58 (102.77)	344.96 (101.96)	340.17 (108.16)	<0.0001
Vitamin B12 (µg/d)	6.04 (5.51)	5.90 (4.78)	5.78 (4.51)	5.63 (4.90)	<0.0001
Vitamin C (mg/d)	130.32 (81.78)	122.37 (64.31)	116.48 (65.62)	108.50 (63.77)	<0.0001
Vitamin D (µg/d)	2.98 (2.25)	2.95 (2.00)	2.89 (1.91)	2.87 (2.09)	<0.0001
Vitamin E (mg/d)	11.76 (4.65)	11.96 (4.33)	12.08 (4.51)	12.07 (4.74)	0.001

Abbreviations: SD, standard deviation; EI, energy intake; SFA, saturated fatty acids; MUFA, monounsaturated fatty acids.

^aP-values for trend are obtained with multivariable linear regression with linear contrast adjusted for sex, age, EI.

^bComplex carbohydrates refer to carbohydrates that are converted into glucose during digestion (starches such as amylose and amylopectin), as opposed to simple carbohydrates such as glucose, lactose and fructose.

eTable 16. Association Between Ultra-processed Food Consumption and Nutrient Intake of Adults From the Study Population (n = 44,551)

Nutrient	Proportion of ultra-processed food in the diet (in % total energy intake)		
	% change in nutrient intake ^a	SE	P-value ^b
mPNNS-GS	-3.95	0.001	<0.0001
EI (kcal/d)	0.66	0.001	<0.0001
Carbohydrates (% EI)	0.78	0.001	<0.0001
Protein (% EI)	-2.55	0.001	<0.0001
Lipids (% EI)	1.58	0.001	<0.0001
Alcohol (% EI)	-8.60	0.007	<0.0001
Alcohol (g/d)	-8.60	0.007	<0.0001
Complex carbohydrates ^c (g/d)	-1.48	0.001	<0.0001
Simple carbohydrates (g/d)	3.88	0.001	<0.0001
Fibers (g/d)	-5.46	0.001	<0.0001
SFA (g/d)	4.43	0.001	<0.0001
MUFA (g/d)	0.51	0.001	<0.0001
n-3 fatty acids (g/d)	-5.41	0.002	<0.0001
n-6 fatty acids (g/d)	1.08	0.001	<0.0001
Cholesterol (g/d)	0.40	0.002	0.02
Animal protein (g/d)	-1.69	0.002	<0.0001
Plant protein (g/d)	-3.57	0.001	<0.0001
Sodium (mg/d)	0.68	0.001	<0.0001
Potassium (mg/d)	-3.92	0.001	<0.0001
Calcium (mg/d)	-1.23	0.001	<0.0001
Iron (mg/d)	-2.18	0.001	<0.0001
Beta-carotene (µg/d)	-9.23	0.003	<0.0001
Vitamin B6 (mg/d)	-2.73	0.001	<0.0001
Vitamin B9 (µg/d)	-3.96	0.001	<0.0001
Vitamin B12 (µg/d)	-3.37	0.003	<0.0001
Vitamin C (mg/d)	-7.81	0.002	<0.0001
Vitamin D (µg/d)	-1.99	0.003	<0.0001
Vitamin E (mg/d)	-0.22	0.001	0.1

Abbreviations: SE, standard error; EI, energy intake; SFA, saturated fatty acids; MUFA, monounsaturated fatty acids.

^aEstimated using the following transformation of the β coefficient: $100 \times (e^{\beta}) - 1$.

^bP-values are obtained with multivariable linear regression adjusted for sex, age, EI.

^cComplex carbohydrates refer to carbohydrates that are converted into glucose during digestion (starches such as amylose and amylopectin), as opposed to simple carbohydrates such as glucose, lactose and fructose.

eTable 17. Nutrient Intake According to Quartiles of the Energy-weighted Proportion of Ultra-processed Food in the Diet of Adults From the Study Population (n = 44,551)

Nutrient	Proportion of ultra-processed food in the diet (in % total energy intake)				P-trend ^a
	Quartile 1	Quartile 2	Quartile 3	Quartile 4	
	<21.6%	21.6-28.2%	28.2-35.7%	>35.7%	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
mPNNS-GS	8.65 (1.64)	8.38 (1.64)	8.12 (1.63)	7.70 (1.62)	<0.0001
EI (kcal/d)	1864.29 (458.41)	1906.34 (447.80)	1906.69 (445.98)	1899.62 (462.83)	<0.0001
Carbohydrates (% EI)	40.65 (7.54)	40.97 (6.64)	41.02 (6.48)	41.29 (6.51)	<0.0001
Protein (% EI)	18.18 (4.14)	17.61 (3.42)	17.27 (3.26)	16.82 (3.31)	<0.0001
Lipids (% EI)	37.36 (6.63)	37.82 (5.76)	38.23 (5.51)	38.98 (5.58)	<0.0001
Alcohol (% EI)	3.82 (4.66)	3.60 (4.15)	3.48 (4.04)	2.92 (3.88)	<0.0001
Alcohol (g/d)	10.68 (14.14)	10.33 (12.98)	9.90 (12.47)	8.25 (11.84)	<0.0001
Complex carbohydrates (g/d)	104.45 (41.53)	105.02 (37.93)	102.96 (35.57)	99.92 (34.68)	<0.0001
Simple carbohydrates (g/d)	84.66 (31.05)	89.68 (29.51)	91.75 (29.75)	95.08 (32.71)	<0.0001
Fibers (g/d)	22.55 (7.78)	21.58 (6.81)	20.66 (6.38)	19.41 (6.59)	<0.0001
SFA (g/d)	29.74 (11.12)	32.12 (11.01)	32.97 (11.13)	34.12 (11.79)	<0.0001
MUFA (g/d)	30.00 (10.88)	30.26 (9.45)	30.53 (9.54)	30.83 (9.97)	0.6
n-3 fatty acids (g/d)	1.67 (0.95)	1.58 (0.80)	1.52 (0.73)	1.40 (0.70)	<0.0001
n-6 fatty acids (g/d)	9.57 (5.32)	9.57 (4.32)	9.54 (4.00)	9.67 (4.09)	0.7
Cholesterol (g/d)	313.73 (132.53)	324.17 (126.04)	325.38 (122.85)	322.49 (128.64)	0.01
Animal protein (g/d)	56.19 (20.00)	56.39 (18.24)	55.64 (17.90)	54.18 (18.60)	<0.0001
Plant protein (g/d)	26.91 (9.03)	26.30 (8.17)	25.56 (7.68)	24.62 (8.12)	<0.0001
Sodium (mg/d)	2709.88 (914.21)	2823.06 (881.15)	2830.85 (874.56)	2778.90 (902.52)	<0.0001
Potassium (mg/d)	3305.40 (838.83)	3218.28 (762.75)	3135.41 (731.74)	2992.10 (746.73)	<0.0001
Calcium (mg/d)	940.43 (298.36)	944.60 (283.96)	932.74 (276.45)	921.28 (285.58)	<0.0001
Iron (mg/d)	14.34 (4.88)	14.27 (4.63)	14.05 (4.46)	13.66 (4.60)	<0.0001
Beta-carotene (µg/d)	4232.59 (2729.9)	3948.23 (2351.5)	3722.72 (2282.4)	3364.85 (2239.7)	<0.0001
Vitamin B6 (mg/d)	1.84 (0.52)	1.81 (0.51)	1.79 (0.52)	1.75 (0.57)	<0.0001
Vitamin B9 (µg/d)	361.96 (114.89)	351.98 (102.85)	343.06 (101.00)	328.16 (105.67)	<0.0001
Vitamin B12 (µg/d)	6.18 (5.65)	6.03 (4.97)	5.76 (4.59)	5.38 (4.43)	<0.0001

Vitamin C (mg/d)	129.94 (83.37)	122.64 (62.31)	117.55 (57.48)	107.53 (71.05)	<0.000 1
Vitamin D (µg/d)	3.05 (2.37)	2.95 (2.00)	2.91 (1.93)	2.77 (1.91)	<0.000 1
Vitamin E (mg/d)	11.93 (4.88)	11.98 (4.40)	11.96 (4.35)	11.99 (4.60)	0.09

Abbreviations: SD, standard deviation; EI, energy intake; SFA, saturated fatty acids; MUFA, monounsaturated fatty acids.
^aP-values for trend are obtained with multivariable linear regression with linear contrast adjusted for sex, age, EI.

eTable 18. Association Between Quartiles of Proportion of Ultra-processed Food in the Diet and Overall Mortality Risk in Adults From the NutriNet-Santé Cohort (n = 44,551)

	No of cases/no n-cases	Proportion of ultra-processed food in the diet (in weight)							
		Quartiles ^a							
		Q1	Q2		Q3		Q4		P-trend ^b
	HR	95% CI	HR	95% CI	HR	95% CI			
Imputed data									
Model 1	602/43949	Ref .	0.97	[0.76-1.22]	1.07	[0.85-1.34]	1.25	[1.00-1.56]	0.03
Model 2	602/43949	Ref .	1.06	[0.84-1.34]	1.18	[0.94-1.49]	1.26	[1.00-1.58]	0.03
Model 3	602/43949	Ref .	1.06	[0.84-1.34]	1.18	[0.93-1.48]	1.25	[0.99-1.57]	0.04

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval

^aCut-offs for quartiles of UPFp were 9.3%, 13.2%, and 18.0%.

^bP-values for trend obtained with Cox proportional hazard model using quartiles as continuous variables.

Model 1: Adjusted for sex and age.

Model 2: Adjusted for model 1 + income level, education level, marital status, residence, BMI, physical activity, smoking status, energy intake, alcohol intake, season of food records, 1st degree family history of cancer or cardiovascular diseases, number of food records.

Model 3: Adjusted for model 2 + mPNNs-GS

eTable 19. Association Between the Proportion of Ultra-processed Food in the Diet and Overall Mortality Risk in Adults From the NutriNet-Santé Cohort (Primary Analysis, Case Complete)

Proportion of ultra-processed food in the diet (in weight)												
	No of cases/non-cases	Continuous			Quartiles ^a							
		HR ^b	95% CI	P ^c	Q1	Q2		Q3		Q4		P-trend ^d
						HR	95% CI	HR	95% CI	HR	95% CI	
Case complete												
Model 1	602/43949	1.20	[1.08-1.32]	0.0004	Ref.	0.97	[0.76-1.22]	1.07	[0.85-1.34]	1.25	[1.00-1.56]	0.03
Model 2	468/33890	1.20	[1.07-1.34]	0.001	Ref.	1.01	[0.77-1.32]	1.22	[0.94-1.59]	1.32	[1.02-1.71]	0.02
Model 3	386/28993	1.19	[1.05-1.35]	0.006	Ref.	0.93	[0.69-1.26]	1.19	[0.89-1.58]	1.29	[0.97-1.72]	0.03

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval

^aCut-offs for quartiles of UPFp were 9.3%, 13.2%, and 18.0%.

^bHR for an increase of 10% of UPFp

^cP-values obtained with Cox proportional hazard model using UPFp as a continuous variable.

^dP-values for trend obtained with Cox proportional hazard model using quartiles as continuous variables.

Model 1: Adjusted for sex and age.

Model 2: Adjusted for model 1 + income level, education level, marital status, residence, BMI, physical activity, smoking status, energy intake, alcohol intake, season of food records, 1st degree family history of cancer or cardiovascular diseases, number of food records.

Model 3: Adjusted for model 2 + mPNNs-GS.

eTable 20. Association Between the Energy-weighted Proportion of Ultra-processed Food in the Diet and Overall Mortality Risk in Adults From the NutriNet-Santé Cohort (n = 44,551)

Proportion of ultra-processed food in the diet (in energy)												
	No of cases/ non-cases	Continuous			Quartiles ^a							
		H R ^b	95% CI	P ^c	Q 1	Q2		Q3		Q4		P- trend ^d
						H R	95% CI	H R	95% CI	H R	95% CI	
Case complete												
Model 1	602/43 949	1.07	[0.99-1.16]	0.07	R ef.	0.92	[0.74-1.15]	0.85	[0.68-1.07]	1.21	[0.97-1.51]	0.2
Model 2	468/33 890	1.07	[0.98-1.16]	0.11	R ef.	0.93	[0.73-1.19]	0.81	[0.62-1.06]	1.11	[0.86-1.42]	0.8
Model 3	386/28 993	1.07	[0.97-1.17]	0.22	R ef.	0.84	[0.64-1.11]	0.79	[0.59-1.06]	1.10	[0.83-1.45]	0.8

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval

^aCut-offs for quartiles of UPF proportion were 21.6%, 28.2%, and 35.7%.

^bHR for an increase of 10% of UPFp

^cP-values obtained with Cox proportional hazard model using UPFp as a continuous variable.

^dP-values for trend obtained with Cox proportional hazard model using quartiles as continuous variables.

Model 1: Adjusted for sex and age.

Model 2: Adjusted for model 1 + income level, education level, marital status, residence, BMI, physical activity, smoking status, energy intake, alcohol intake, season of food records, 1st degree family history of cancer or cardiovascular diseases, number of food records.

Model 3: Adjusted for model 2 + mPNNS-GS.

eTable 21. Association Between the Proportion of Ultra-processed Food in the Diet and Overall Mortality Risk in Adults from the NutriNet-Santé Cohort (Sensitivity Analyses, Case Complete)

Proportion of ultra-processed food in the diet (in weight)												
	No of cases/non-cases	Continuous			Quartiles ^a							
		HR ^b	95% CI	P ^c	Q1	Q2		Q3		Q4		P-trend ^d
						HR	95% CI	HR	95% CI	HR	95% CI	
Sensitivity analysis 1 - Case complete												
Model 1	516/43949	1.1 4	[1.02- 1.28]	0.02	Ref .	0.9 5	[0.74- 1.22]	1.0 1	[0.79- 1.29]	1.1 8	[0.93- 1.50]	0.2
Model 2	398/33890	1.1 6	[1.02- 1.31]	0.02	Ref .	0.9 8	[0.73- 1.31]	1.1 4	[0.86- 1.51]	1.2 5	[0.94- 1.65]	0.07
Model 3	328/28993	1.1 4	[0.99- 1.31]	0.07	Ref .	0.8 5	[0.62- 1.18]	1.1 2	[0.82- 1.52]	1.2 0	[0.88- 1.64]	0.1
Sensitivity analysis 2 - Case complete												
Model 3 + CVDs and cancer at baseline	386/28993	1.1 7	[1.04- 1.33]	0.01	Ref .	0.9 4	[0.69- 1.27]	1.1 7	[0.88- 1.56]	1.2 8	[0.96- 1.71]	0.04
Sensitivity analysis 3 - Case complete												
Model 3 + western	386/28993	1.1 9	[1.05- 1.35]	0.00 6	Ref .	0.9 3	[0.69- 1.26]	1.1 9	[0.89- 1.58]	1.2 9	[0.97- 1.72]	0.03
Sensitivity analysis 4 - Case complete												
Model 1	602/43949	1.0 5	[1.01- 1.09]	0.03	Ref .	0.8	[0.63- 1.02]	1.0 2	[0.81- 1.27]	1.0 8	[0.87- 1.35]	0.2
Model 2	468/33890	1.0 7	[1.02- 1.11]	0.00 3	Ref .	0.9 1	[0.7-1.19]	1.1 2	[0.86- 1.46]	1.3 2	[1.02- 1.72]	0.02
Model 3	386/28993	1.0 6	[1.01- 1.12]	0.01	Ref .	0.8 8	[0.65-1.2]	1.1 7	[0.88- 1.56]	1.3 5	[1.01-1.8]	0.01
Sensitivity analysis 5 - Case complete												
Model 1	362/39091	1.1 3	[0.99- 1.30]	0.06	Ref .	0.9 1	[0.67- 1.23]	1.1 1	[0.83- 1.47]	1.1 9	[0.89- 1.59]	0.1
Model 2	281/30196	1.1 7	[1.01- 1.35]	0.04	Ref .	0.9 7	[0.69- 1.38]	1.3 5	[0.97- 1.88]	1.3 1	[0.94- 1.83]	0.04
Model 3	229/25841	1.1 6	[0.98- 1.37]	0.08	Ref .	0.8 1	[0.55- 1.21]	1.2 6	[0.88- 1.81]	1.2 4	[0.86-1.8]	0.08

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval

^aCut-offs for quartiles of UPFp were 9.3%, 13.2%, and 18.0%.

^bHR for an increase of 10% of UPFp, except for sensitivity analysis 4, HR for an increase of 100 grams of UPF in the diet.

^cP-values obtained with Cox proportional hazard model using UPFp as a continuous variable.

^dP-values for trend obtained with Cox proportional hazard model using quartiles as continuous variables.

Model 1: Adjusted for sex and age.

Model 2: Adjusted for model 1 + income level, education level, marital status, residence, BMI, physical activity, smoking status, energy intake, alcohol intake, season of food records, 1st degree family history of cancer or cardiovascular diseases, number of food records.

Model 3: Adjusted for model 2 + mPNNs-GS.

Sensitivity analysis 1: exclusion of death cases in the first two years of follow-up;

Sensitivity analysis 2: exclusion of death cases in the first year of follow-up + further adjustments in model 3 for prevalent CVDs and cancer at baseline;

Sensitivity analysis 3: exclusion of death cases in the first year of follow-up + further adjustments in model 3 for a western dietary pattern derived from principal component analysis;

Sensitivity analysis 4: exclusion of death cases in the first year of follow-up, UPF measured as absolute amount consumed in weight;

Sensitivity analysis 5: exclusion of death cases in the first year of follow-up + exclusion of prevalent cases of cardiovascular diseases and cancer.

eTable 22. Association Between the Proportion of Ultra-processed Food in the Diet and Overall Mortality Risk in Adults From the NutriNet-Santé Cohort (Sensitivity Analyses, Imputed Data)

Proportion of ultra-processed food in the diet (in weight)												
	No of cases/non-cases	Continuous			Quartiles ^a							
		HR ^b	95% CI	P ^c	Q1	Q2		Q3		Q4		P-trend ^d
					HR	95% CI	HR	95% CI	HR	95% CI		
Sensitivity analysis 1 - Imputed data												
Model 1	-	-	-	-	-	-	-	-	-	-	-	-
Model 2	516/43949	1.1 1	[0.99- 1.23]	0.07	Ref .	1.0 3	[0.80- 1.32]	1.1 1	[0.86- 1.42]	1.1 9	[0.93- 1.53]	0.1
Model 3	516/43949	1.1 1	[0.99- 1.24]	0.07	Ref .	1.0 3	[0.80- 1.33]	1.1 1	[0.87- 1.43]	1.2 0	[0.94- 1.54]	0.1
Sensitivity analysis 2 - Imputed data												
Model 3 + CVDs and cancer at baseline	602/43949	1.1 3	[1.02- 1.25]	0.02	Ref .	1.0 6	[0.84- 1.34]	1.1 6	[0.92- 1.46]	1.2 4	[0.98- 1.57]	0.05
Sensitivity analysis 3 - Imputed data												
Model 3 + western	602/43949	1.1 4	[1.03- 1.26]	0.00 9	Ref .	1.0 6	[0.84- 1.34]	1.1 8	[0.93- 1.48]	1.2 5	[0.98- 1.57]	0.04
Sensitivity analysis 4 - Imputed data												
Model 1	-	-	-	-	-	-	-	-	-	-	-	-
Model 2	602/43949	1.0 6	[1.02- 1.10]	0.00 3	Ref .	0.9 2	[0.72- 1.16]	1.2 0	[0.96- 1.51]	1.2 5	[0.99- 1.58]	0.01
Model 3	602/43949	1.0 6	[1.02- 1.10]	0.00 4	Ref .	0.9 1	[0.72- 1.16]	1.2 0	[0.96- 1.51]	1.2 5	[0.99- 1.58]	0.02
Sensitivity analysis 5 - Imputed data												
Model 1	-	-	-	-	-	-	-	-	-	-	-	-
Model 2	362/39091	1.1 2	[0.98- 1.27]	0.09	Ref .	1.0 1	[0.74- 1.37]	1.2 7	[0.95- 1.71]	1.2 6	[0.94- 1.69]	0.05
Model 3	362/39091	1.1 2	[0.98- 1.28]	0.09	Ref .	1.0 1	[0.75- 1.37]	1.2 8	[0.96- 1.72]	1.2 7	[0.94- 1.72]	0.05

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval
^aCut-offs for quartiles of UPFp were 9.3%, 13.2%, and 18.0%.

^bHR for an increase of 10% of UPFp, except for sensitivity analysis 4, HR for an increase of 100 grams of UPF in the diet.

^cP-values obtained with Cox proportional hazard model using UPFp as a continuous variable.

^dP-values for trend obtained with Cox proportional hazard model using quartiles as continuous variables.

Model 1: Adjusted for sex and age.

Model 2: Adjusted for model 1 + income level, education level, marital status, residence, BMI, physical activity, smoking status, energy intake, alcohol intake, season of food records, 1st degree family history of cancer or cardiovascular diseases, number of food records.

Model 3: Adjusted for model 2 + mPNNs-GS.

Sensitivity analysis 1: exclusion of death cases in the first two years of follow-up;

Sensitivity analysis 2: exclusion of death cases in the first year of follow-up + further adjustments in model 3 for prevalent CVDs and cancer at baseline;

Sensitivity analysis 3: exclusion of death cases in the first year of follow-up + further adjustments in model 3 for a western dietary pattern derived from principal component analysis;

Sensitivity analysis 4: exclusion of death cases in the first year of follow-up, UPF measured as absolute amount consumed in weight;

Sensitivity analysis 5: exclusion of death cases in the first year of follow-up + exclusion of prevalent cases of cardiovascular diseases and cancer.

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