

The image features a top border with fresh produce including tomatoes, a green apple, broccoli, and a banana. The bottom border shows processed foods such as a burger, fries, pizza, and dipping sauces. The central text is contained within a white rounded rectangle.

# Health Implications of Processed Foods:

What's the big deal?

JONATHAN GRIMWOOD

# Things to Look Forward to...

- What ARE processed foods?
- Why is THIS important?
- What do we ALREADY know?
- What is the IMPACT?
- What can we DO?

I wonder what I can do to start eating healthier...



**NO MORE  
PROCESSED  
FOODS!**



# Processed Foods vs. Ultra-Processed

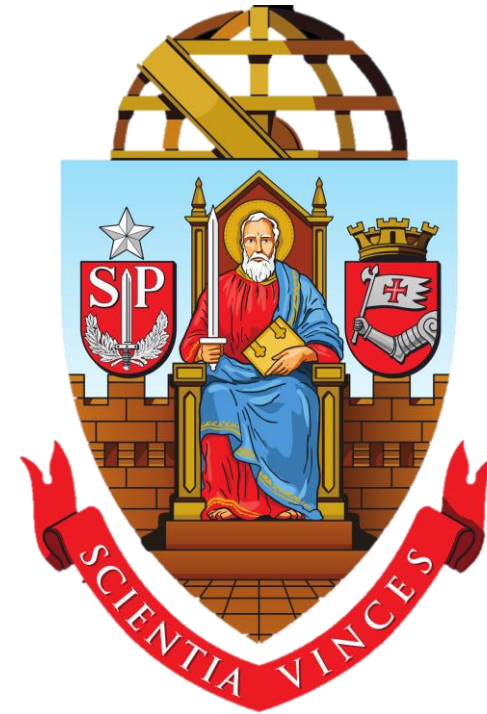
## NOVA Classifications

### Processed Foods

- Undergone change before being sold

### Ultra-Processed Foods

- Typically 5+ ingredients
- Substances not often used in culinary prep
  - Hydrolyzed protein
  - Modified starches
  - Hydrogenated oils
- Additives to improve appeal
  - Texture/color



School of Public Health  
University of Sao Paulo, Brazil

Gibney (2019)

# NOVA Classifications

## Group 1

Unprocessed &  
minimally  
processed foods

## Group 2

Processed culinary or  
food industry  
ingredients

## Group 3

Ultra-processed foods

Group ~~3~~ 3

Processed food  
products

Group ~~3~~ 4

Ultra-processed  
food products



## Group 3

### Processed foods

“Generally produced to be consumed as part of meals or dishes or may be used together with ultra-processed products to replace food-based freshly prepared dishes and meals.”

**TABLE 1** Evolution of definitions of the term ultra-processed foods (2010–2017)

Year	Reference	Definition
2009	6	These are made up from group 2 substances (Group 2 is of substances extracted from whole foods) to which either no or relatively small amounts of minimally processed foods (Group 1) are added, plus salt, and other preservatives, and often also cosmetic additives.
2010	7	This group is defined as a process that mixes Group 2 ingredients (processed culinary or food industry ingredients) and Group 1 foodstuffs (unprocessed or minimally processed foods) to create durable, accessible, convenient, and palatable ready-to-eat or ready-to-heat food products liable to be consumed as snacks or desserts or to replace home-prepared dishes.
2012	8	These are formulated mostly or entirely from ingredients and typically contain no whole foods. The purpose is to devise durable, convenient, high- or ultra-palatable, and profitable products. They typically are not recognized as versions of foods. Most are designed to be consumed by themselves or in combination as snacks or drinks. Most of the ingredients used by manufacturers are not available in supermarkets or other retail outlets. Although some are directly derived from foods, such as oils, fats, starches, and sugars, others are obtained by the further processing of food constituents. Numerically, the great majority of ingredients of ultra-processed products are additives of various types that include among others, bulkers, sweeteners, sensory enhancers, flavors, and colors.
2014	4	Formulated mostly or entirely from substances derived from foods. Typically contain little or no whole foods. Durable, convenient, accessible, highly or ultra-palatable, often habit-forming. Typically not recognizable as versions of foods, although may imitate the appearance, shape, and sensory qualities of foods. Many ingredients not available in retail outlets. Some ingredients directly derived from foods, such as oils, fats, flours, starches, and sugar. Others obtained by further processing of food constituents. Numerically the majority of ingredients are preservatives; stabilizers, emulsifiers, solvents, binders, bulkers; sweeteners, sensory enhancers, colors and flavors; processing aids and other additives. Bulk may come from added air or water. Micronutrients may "fortify" the products. Most are designed to be consumed by themselves or in combination as snacks. They displace food-based freshly prepared dishes, meals. Processes include hydrogenation, hydrolysis; extruding, molding, reshaping; preprocessing by frying, baking.
2015	9	The third group (ultra-processed foods) is composed of industrial products that are made entirely or mostly made from substances that have been extracted from food (oils, fats, sugar, starch, proteins), those that are derived from food constituents (hydrogenated fats, modified starches), or foods synthesized in a laboratory based on organic materials such as oil and coal (colorants, flavorings, flavor enhancers, and other additives used to give the products attractive sensory properties).
2016a	5	The fourth NOVA group is of ultra-processed food and drink products. These are industrial formulations typically with 5 or more and usually many ingredients. Such ingredients often include those also used in processed foods, such as sugar, oils, fats, salt, antioxidants, stabilizers, and preservatives. Ingredients only found in ultra-processed products include substances not commonly used in culinary preparations, and additives whose purpose is to imitate sensory qualities of group 1 foods or of culinary preparations of these foods, or to disguise undesirable sensory qualities of the final product.
2016b	10	Formulations of several ingredients that, besides salt, sugar, oils and fats, include food substances 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 and their culinary preparations or to disguise undesirable qualities of the final product.
2017	11	Industrial formulations typically with 5 or more and usually many ingredients. Besides salt, sugar, oils, and fats, ingredients of ultra-processed foods include food substances not commonly used in culinary preparations, such as hydrolyzed protein, modified starches, and hydrogenated or interesterified oils, and additives whose purpose is to imitate sensorial qualities of unprocessed or minimally processed foods and their culinary preparations or to disguise undesirable qualities of the final product, such as colorants, flavorings, nonsugar sweeteners, emulsifiers, humectants, sequestrants, and firming, bulking, de-foaming, anticaking, and glazing agents.

## Group 2

### Processed culinary ingredients

- Substances extracted from foods and used in kitchens to transform unprocessed/minimally processed foods
- Culinary preparation

## Group 3

### Processed foods

- Food products manufactured with the inclusion of processed culinary ingredients

## Group 4

### Ultra-processed foods

- Typically 5+ ingredients
- Substances not often used in culinary prep
  - Hydrolyzed protein
  - Modified starches
  - Hydrogenated oils
- Additives to improve appeal
  - Texture/color



# NOVA Classifications

## Group 1

Unprocessed or minimally  
processed foods

## Group 2

Processed culinary  
ingredients

## Group 3

Processed foods

## Group 4

Ultra-processed foods

# Unprocessed/Minimally Processed



+

# Processed Culinary Ingredients



=

# Processed Foods



# Ultra-Processed Foods



## Why is this important?

- Ultra-processed food associated with increased LDL, HTN, and BG
- Unclear whether association due to nutrient content or processing itself
  - Poti, Braga, & Qin (2017)
- All processing levels (NOVA) contribute to nutrient intake
  - Eicher-Miller, Fulgoni, & Keast (2012)
- More likely to meet recommendations if consuming nutrient-dense foods; processed or not
  - Weaver et al. (2014)

# What do we already know?

Energy Intake Breakdown	Daily Energy Intake (%)
Ultra-Processed	42
Processed Foods	15.8
Processed Culinary Ingredients	6.8
Unprocessed/Minimally Processed	35.4

What is the impact?

# The share of ultra-processed foods and the overall nutritional quality of diets in the US: evidence from a nationally representative cross-sectional study

Steele, Popkin, Swinburn, & Monteiro (2017)

## Objective

To examine the relationship between energy contribution of ultra-processed foods in the U.S. diet and critical nutrient contents.

## Study Design

- Cross-sectional study
  - U.S. residents 2009-2010
  - NHANES Data
- 9,317 participants
  - >1 year old
- Diet
  - Two 24-hour recall interviews
  - 1<sup>st</sup> in person, 2<sup>nd</sup> on phone 3-10 days later
- Food categorized using NOVA classifications



## Breakdown

- Determined energy of ultra-processed food compared to total intake
  - Combined minimally processed and processed culinary ingredients
- Nutrients analyzed using FNDDS 5.0 and USDA National Nutrient Database for Standard Reference
- Adjusted model for:
  - Age
  - Sex
  - Race/ethnicity
  - Family income
  - Education level



## Findings

- 57.5% daily calories coming from ultra processed foods
- 30.2% unprocessed/minimally processed
- 12.2% from processed foods and processed culinary ingredients

% of total intake	Lowest UPF Intake	Highest UPF Intake
Protein	17.9	13.1*
Carbohydrates	46.5	53.4*
Added Sugar	7.7	19.2*
Saturated Fats	10.1	10.9*
Fiber (g/1000 kcals)	9.6	6.7*

\*significant at  $p < 0.001$

Quintile of dietary share of ultra-processed foods (% of total energy intake)<sup>a</sup>

	All quintiles (n = 9,317) (2,069.9 kcal)	Least	Q2 (n = 1,903) (2,017.6 kcal)	Q3 (n = 1,791) (2,061.8 kcal)	Q4 (n = 1,785) (2,151.5 kcal)	Most
Ultra-processed foods	57.5	32.6	48.6	58.4	67.3	80.7*
Breads	9.5	7.2	9.9	10.3	10.6	9.4*
Soft and fruit drinks <sup>g</sup>	6.9	3	4.7	6.7	8.2	11.8*
Cakes, cookies, and pies	5.5	2.6	4.6	5.5	6.8	7.9*
Salty snacks	4.4	2.4	3.7	4.3	5.4	6.2*
Frozen and shelf-stable plate meals	3.9	1.3	2.2	3.7	5.2	7.3*
Pizza (ready-to-eat/heat)	3.3	0.5	1.4	2.6	4.1	7.8*
Breakfast cereals	3.1	2.2	3.2	3.6	3.5	3.1
Sauces, dressings, and gravies	2.5	2.4	2.7	2.7	2.8	2.1
Reconstituted meat or fish products	2.3	0.9	2.1	2.4	2.9	2.9*
Ice cream and ice pops	2.3	1.1	1.9	2.4	2.9	3*
Sweet snacks	2.3	1.1	2.1	2.4	2.7	3.4*
Milk-based drinks	1.9	1.1	1.7	1.9	2.1	2.6*
Desserts <sup>h</sup>	1.8	1.3	1.9	2.1	2.1	1.8*
French fries and other potato products	1.7	0.4	1.1	1.7	1.9	3.5*
Sandwiches and hamburgers on bun (ready-to-eat/heat)	1.4	0.2	0.5	1.2	1.5	3.5*

Quintile of dietary share of ultra-processed foods  
(% of total energy intake)<sup>a</sup>

	All quintile (n = 9,317) (2,069.9 kcal)	Least (n = 1,839) (2,017.6 kcal)	Q2 (n = 1,903) (2,017.6 kcal)	Q3 (n = 1,791) (2,061.8 kcal)	Q4 (n = 1,785) (2,151.5 kcal)	Most
Unprocessed or minimally processed foods	30.2	48.3	36.7	29.4	23.3	13.2*
Meat (includes poultry)	8.0	11.6	9.6	8	6.7	4*
Fruit and freshly squeezed fruit juices	5.5	8.8	6.8	5.4	4.3	2.5*
Milk and plain yogurt	5.1	6.4	6.1	5.3	4.8	2.9*
Grains	2.9	6.3	3.4	2.3	1.6	0.7*
Roots and tubers	1.7	2.6	2.3	1.7	1.2	0.7*
Eggs	1.5	2.1	1.8	1.4	1.2	0.7*
Pasta	1.4	2.4	1.6	1.4	1.1	0.5*
Legumes	0.9	1.8	1.1	0.8	0.5	0.2*
Fish and seafood	0.8	1.5	1	0.7	0.4	0.2*
Vegetables	0.9	1.5	1	0.8	0.6	0.4*
Other unprocessed or minimally processed foods <sup>b</sup>	1.7	3.2	2	1.5	1	0.5*

# Outstanding Thoughts

- Large, representation of population
  - Not much detail
- Analyzed specific nutrients
  - Sodium was not significantly different
- Only two diet recalls within two weeks
  - Small time frame
- Broke down details of macro- and micronutrients.
  - Can dig into the nutritional differences
- Limited with NHANES survey
  - Fewer food items included

## EAL Grading

Criteria	Steele et al. (2017)	Rauber et al. (2018)	Srouf et al. (2019)
Overall Grade	∅		
Topic	UPF & Nutrients		
No Selection Bias Comment:	X Loosely defined criteria		
Comparable Study Group Comment:	✓ All measured the same		
Data Collection/Analysis Comment:	✓ NHANES		
Outcomes Defined Comment:	✓ Energy vs. UPF vs. Nutrients		
Measurement Valid Comment:	✓ CDC		
Other Comments:	Few details about population. Data collectors blinded.		

# Ultra-Processed Food Consumption and Chronic Non-Communicable Diseases-Related Dietary Nutrient Profile in the UK (2008-2014)

Rauber et al. (2018)

## Objective

To examine the association between ultra-processed food intake and diet-related recommendations for preventing non-communicable diseases

# Non-Communicable Diseases

Chronic disease that develop as a result of a combination of genetic, physiological, environmental, and behavioral factors.

Responsible for 70% of all deaths worldwide.

## Examples

- CVD
- Cancer
- Diabetes
- Lung Disease



**World Health  
Organization**

## Study Design

- Cross-sectional study
  - U.K. 2008-2014
  - U.K. National Diet and Nutrition Survey
- 9,374 participants
  - >1.5 years old
  - 4738 adults – 4636 children
- Diet
  - Four-day food diary w/ interview
  - Food diary reviewed
- Food categorized using NOVA classifications



Public Health  
England



Food  
Standards  
Agency



## Breakdown

- Determined percentage of energy intake from ultra-processed foods
- Used World Health Organization's recommendations to evaluate prevalence of excess/inadequate intake of:
  - Added Sugar (>10% total energy)
  - Saturated fat (>10% total energy)
  - Fiber (<10 g/1000 kcals)
  - Sodium (>1 g/1000 kcals)
  - Potassium (<1.7 g/1000kcal)
- Nutrients analyzed using Department of Health's Nutrient Databank

## Findings

- 56.8% daily calories coming from ultra processed foods
- 30.1% unprocessed/minimally processed
- 13.0% from processed foods and processed culinary ingredients
- As ultra-processed food intake increased, prevalence of inadequate nutrient intake increased

% with inadequate intake	Lowest UPF Intake	Highest UPF Intake
Added sugar	41.9	77.2*
Sodium	55.8	86.7*
Saturated Fat	64.0	80.2*
Fiber	73.7	93.6*
Potassium	56.1	92.4*

\*significant at  $p < 0.01$

Rauber et al. (2018)

Least

Most

	Least				Most
<b>Ultra-processed foods</b>	<b>34.89</b>	<b>48.74</b>	<b>57.06</b>	<b>65.37</b>	<b>78.06 *</b>
Industrialised packaged breads	8.43	10.87	11.60	11.87	12.27 *
Packaged pre-prepared meals <sup>h</sup>	3.78	5.57	7.19	9.29	12.46 *
Breakfast cereals	3.58	4.43	4.69	4.87	4.21 *
Sausage and other reconstituted meat products	2.57	3.51	3.94	4.09	5.08 *
Confectionery	1.67	2.60	3.37	4.38	5.71 *
Biscuits	2.28	2.89	3.48	4.21	4.44 *
Pastries, buns, and cakes	1.99	2.92	3.51	3.87	4.00 *
Industrial chips (French fries)	1.21	1.73	2.59	3.35	5.07 *
Soft drinks, fruit drinks, and fruit juices	0.94	1.62	2.21	2.86	4.82 *
Milk-based drinks	1.40	2.15	2.38	2.41	2.80 *
Packaged salty snacks	0.95	1.44	1.81	2.50	3.41 *
Industrial pizza	0.50	1.10	1.67	2.29	3.65 *
Margarine and other spreads	1.31	2.02	2.27	2.51	2.83 *
Sauces, dressing, and gravies	2.02	2.30	2.20	2.24	1.82
Industrial desserts	0.50	0.81	1.00	0.93	1.10 *
Other ultra-processed foods <sup>i</sup>	1.58	2.56	3.01	3.51	4.72 *

NOVA Food Groups <sup>a</sup>	Quintiles of the Contribution of Ultra-Processed Foods to Total Energy Intake				
	Least	Q2	Q3	Q4	Most
<b>Unprocessed or minimally processed foods</b>	<b>44.73</b>	<b>35.16</b>	<b>30.11</b>	<b>24.81</b>	<b>15.95 *</b>
Milk and plain yoghurt	5.76	5.59	5.11	4.75	3.64 *
Potatoes and other tubers and roots	4.40	4.02	3.85	3.08	2.17 *
Fruits	5.23	3.73	3.36	2.62	1.74 *
Red meat	5.05	4.13	3.28	2.53	1.48 *
Poultry	3.89	3.16	2.67	2.33	1.46 *
Cereals <sup>b</sup>	5.57	2.69	2.12	1.44	0.77 *
Pasta	2.59	2.18	1.66	1.53	1.02 *
Eggs	2.03	1.70	1.45	1.29	0.82 *
Vegetables	2.48	1.81	1.50	1.21	0.61 *
Fresh fruit juice <sup>c</sup>	1.43	1.29	1.34	1.15	0.82 *
Fish	2.11	1.45	1.28	0.86	0.42 *
Legumes	1.06	0.76	0.65	0.44	0.23 *
Other unprocessed or minimally processed foods <sup>d</sup>	3.22	2.70	1.88	1.61	0.82 *

## Outstanding Thoughts

- Randomly selected but...
  - Purposely split evenly
- Checked food diary with participants to fill in gaps
- Determined NCD by evaluating dietary risk factors
  - Intake vs WHO recommendations
- Analyzed adults and children
  - Difficulty with children

## Conclusion/Significance

- Significant differences in nutrient content between minimally and ultra-processed foods
- Decreasing amount of ultra-processed food can improve diet quality
- Identified nutrients agree with recommendations for a healthy diet
  - Limit saturated fat
  - Limit added sugar
  - Adequate fiber
  - Adequate protein
- Higher UPF intake increases prevalence of inadequate nutrient intake
  - Risk factors for developing diet-related NCDs (WHO, 2019)
- Correlation  $\neq$  Causation

## EAL Grading

Criteria	Steele et al. (2017)	Rauber et al. (2018)	Srouf et al. (2019)
Overall Grade	∅	∅	
Topic	UPF & Nutrients	UPF & NCD	
No Selection Bias Comment:	X Loosely defined criteria	X Random...but not.	
Comparable Study Group Comment:	✓ All measured the same	✓ Generalizable	
Data Collection/Analysis Comment:	✓ NHANES	✓ NDNS	
Outcomes Defined Comment:	✓ Energy vs. UPF vs. Nutrients	✓ WHO NCD Risk Factors	
Measurement Valid Comment:	✓ CDC	✓ Public Health England	
Other Comments:	Few details about population. Data collectors blinded.	Data collectors blinded.	

# Ultra-processed food intake and risk of cardiovascular disease: prospective cohort study

Srouf et al. (2019)

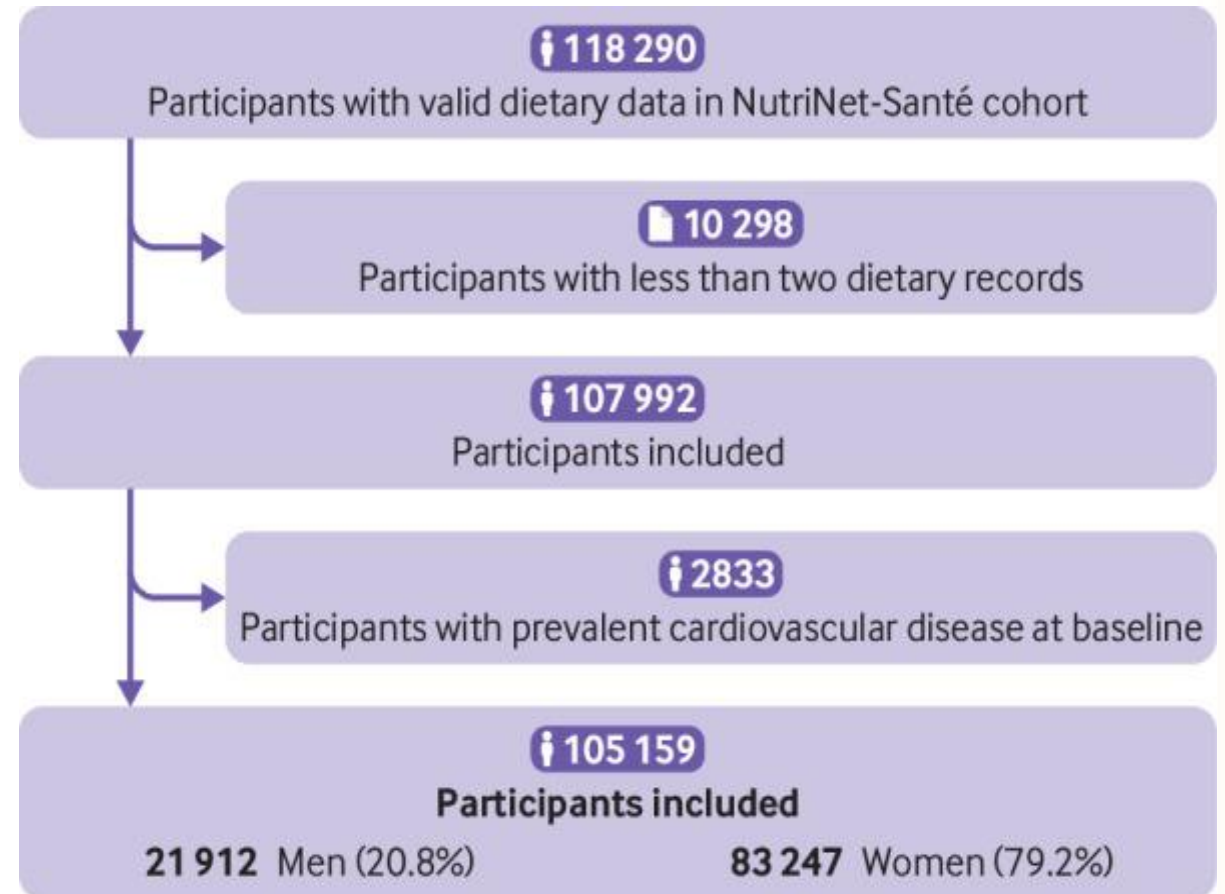
## Objective

To observe the association between consumption of ultra-processed foods and risk of CVD



# Study Design

- Population based cohort study
  - France 2009-2018
  - NutriNet-Santé
- 105,159 participants
  - Average: 42.7 years old
- CVD
  - Yearly questionnaire
  - 3-month check-up
  - Electronic Medical Records
- Diet
  - 24-hour online dietary record every 6 months
  - Foods categorized using NOVA classification

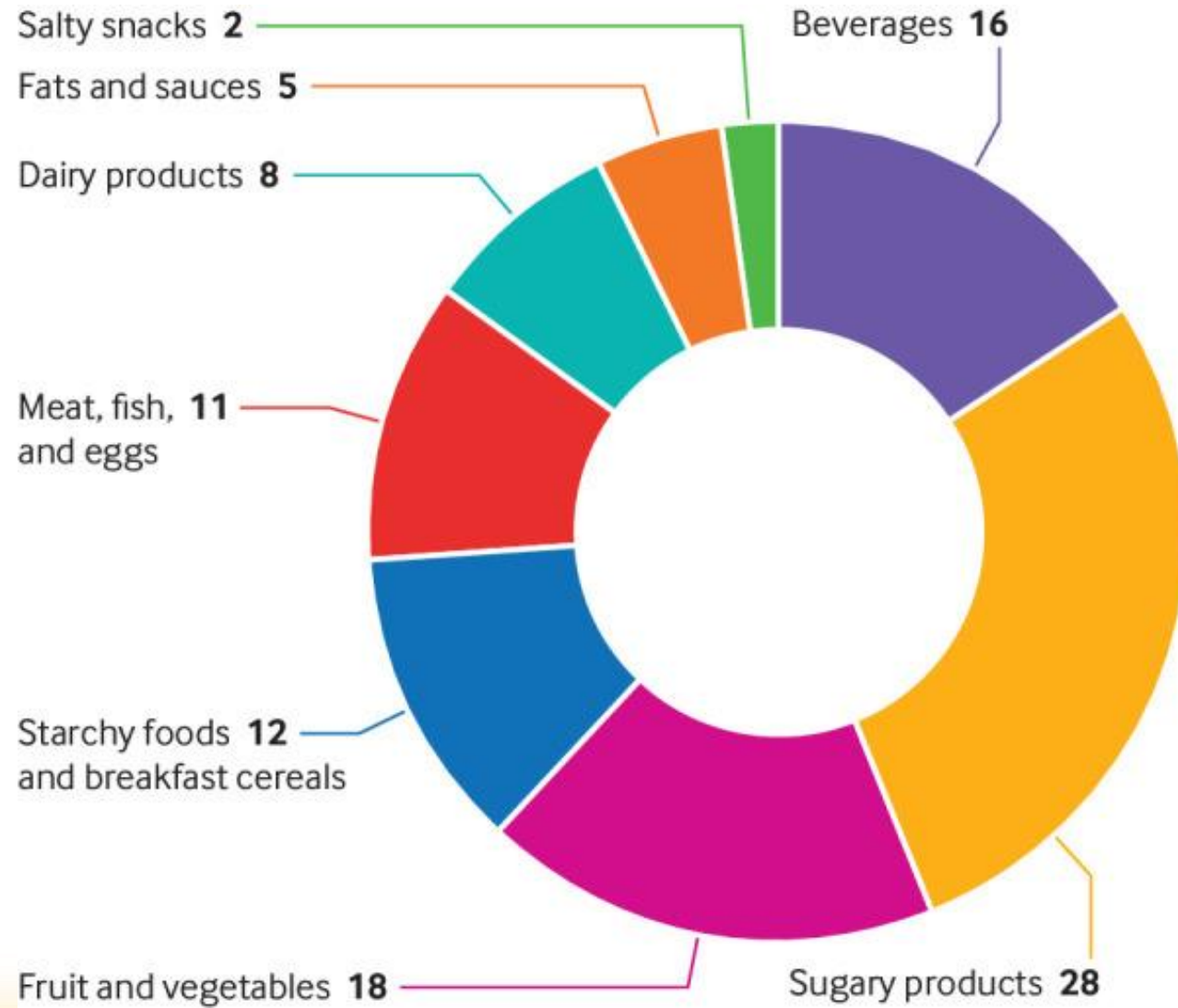


## Breakdown

- Determined weight of ultra-processed food per day
  - Weight accounts for energy-free foods and processes
- Nutri-Score used to calculate nutritional value of foods
- Adjusted for:
  - Saturated fat
  - Sodium
  - Sugar
  - Red meats
  - Beverages
  - Salty snacks



### Relative contribution (%) of each food group to consumption of ultra-processed food in diet



## Findings

- Consumption of ultra-processed foods increased risk of CVD

Incidence of CVD	Lowest UPF intake (n=25,950)	Highest UPF intake (n=25,796)
All CVD	446 (0.02%)	223 (0.008%)*

\*significant at  $p < 0.01$

# Findings

- Nutritional Quality
  - Sodium, energy, fat, sugar, higher glycemic response
  - Known risk factors for CVD
- Ultra-processed contain high levels of glycation end products
  - Sugar sweetened beverages, confectionery snacks, cakes
  - Could accelerate heart disease
- Group with highest ultra-processed consumption
  - Fewer F/V

## Conclusion/Significance

- Confounding factors
  - Smoking, physical activity
- Hard to distinguish which had bigger impact:
  - High UPF
  - Low nutrient-dense foods
- Ultra-processed and CVD relationship remained after adjusting for dietary components
  - May be contributions from bioactive compounds

## Outstanding Thoughts

- Surveys completed using the internet
  - What population could this miss?
- Linked SSN to medical records
- Up-to-date assessment
- Highest quarter of ultra-processed food intake
  - Younger, smokers, less educated, family history of CVD, less physical activity
- Ten years long enough for CVD?
  - In progress
- Weight vs. energy
  - Energy density

## EAL Grading

Criteria	Steele et al. (2017)	Rauber et al. (2018)	Srouer et al. (2019)
Overall Grade	∅	∅	+
Topic	UPF & Nutrients	UPF & NCD	UPF & CVD
No Selection Bias Comment:	X Loosely defined criteria	X Random...but not.	✓ 84% Internet Access
Comparable Study Group Comment:	✓ All measured the same	✓ Generalizable	✓ EMR
Data Collection/Analysis Comment:	✓ NHANES	✓ NDNS	✓ NutriNet-Santé
Outcomes Defined Comment:	✓ Energy vs. UPF vs. Nutrients	✓ WHO NCD Risk Factors	✓ UPF vs. CVD
Measurement Valid Comment:	✓ CDC	✓ Public Health England	✓ Nutritional Epidemiology Research Team
Other Comments:	Few details about population. Data collectors blinded.	Data collectors blinded.	Detail about monitoring health history.



## What can we DO?

- Loosely using the term “processed foods” doesn’t carry much weight
- Identify what makes food products less healthy
  - Added sugar
  - Saturated fat
  - Fiber
  - Sodium
  - Potassium
- Our role as educators
  - Be an informed professional/proactive
  - Understand the “why”
  - Value = more meaningful

## What can we DO?

- Barriers
  - Cost
  - Food availability
  - Longevity (shelf-life)
- Missed opportunities to get nutrients out of “processing” fear
  - Good, Better, Best
- Think about Genetically Modified Foods
  - Scary ≠ Bad

“Nutrition and food science professionals, the food industry, and other stakeholders can help to improve the diets of Americans by providing a nutritious food supply that is safe, enjoyable, affordable, and sustainable by communicating effectively and accurately with each other and by working together to improve the overall knowledge of consumers.”

Weaver et al. (2014)



Thank you!

QUESTIONS?



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