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The NOVA food classification system: rationale, description, and applications

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The NOVA food classification system

- **Rationale**
- **Description**
- **Uses and applications**
- **Developments/improvements**

Rationale for a health-oriented food classification based on food processing?

- The content of **critical nutrients** in foods (and diets) is today largely driven by food processing
- Other health-relevant food attributes are also heavily influenced by food processing:
 - ✓ **The integrity of the food matrix**
 - ✓ **The presence of non-nutrient health-protective food components**
 - ✓ **The presence of contaminants (additives, released from packaging or neoformed)**
 - ✓ **Texture, energy density, palatability, thermic effect, glycemic index etc**
- **Eating patterns** (how, when, where food is eaten) are also influenced by food processing

The idea that healthy diets should be based on un/minimally processed foods and restricted in highly processed foods is now practically consensual



NOVA has provided definitions for un/minimally processed foods and (highly) ultra-processed foods and for two other intermediate groups (processed culinary ingredients and processed foods), all definitions based on the extent and purpose of food processing

Invited commentary

Nutrition and health. The issue is not food, nor nutrients, so much as processing

Orthodox teaching and practice on nutrition and health almost always focuses on nutrients, or else on foods and

Group 1 is of minimally processed foods. It is of whole foods that have been submitted to some process that does

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doi:10.1017/S136898001700023

Commentary

The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing

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Abstract

Given evident multiple threats to food systems and supplies, food security, human

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doi:10.1017/S1368980018003762

Commentary

Ultra-processed foods: what they are and how to identify them

Carlos A Monteiro^{1,2,*}, Geoffrey Cannon², Renata B Levy^{2,3}, Jean-Claude Moubarac⁴, Maria LC Louzada², Fernanda Rauber², Neha Khandpur², Gustavo Cediel², Daniela Neri², Euridice Martinez-Steele², Larissa G Baraldi² and Patricia C Jaime^{1,2}

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Submitted 3 September 2018: Final revision received 21 November 2018: Accepted 30 November 2018: First published online 12 February 2019

Abstract

The present commentary contains a clear and simple guide designed to identify

The NOVA food classification system

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EUFIC - The European Food Information Council

A non-profit organisation established in 1995 and funded by food and drink companies.

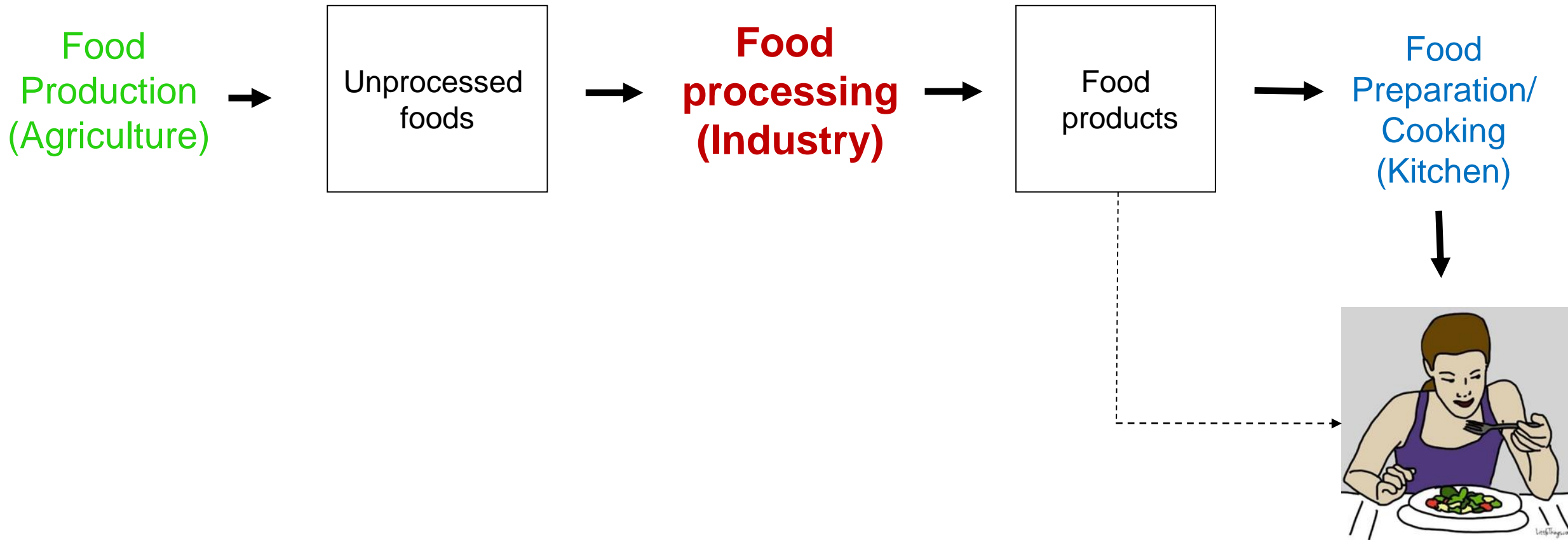
<https://www.eufic.org/en/food-production/article/processed-food-qa>

What is food processing?

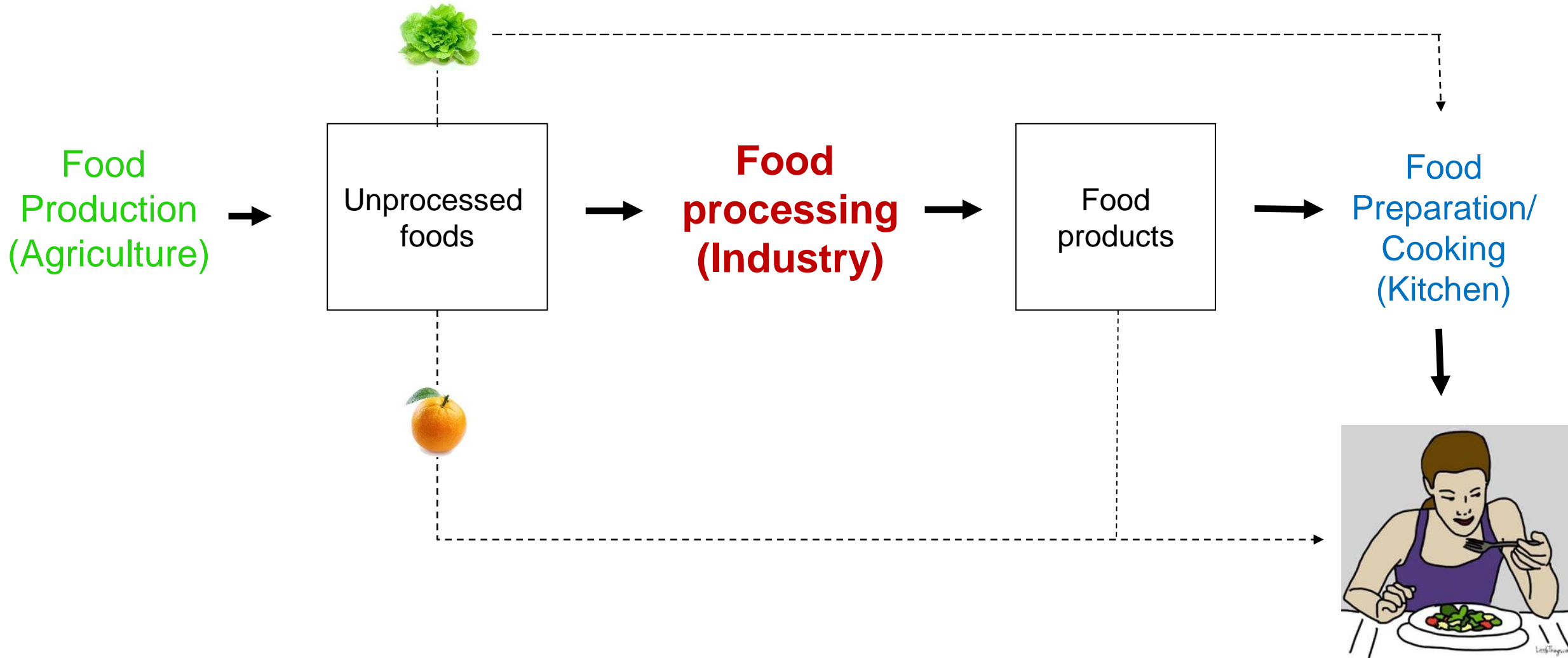
Food processing is any method used to turn fresh foods into food products.¹ This can involve one or a combination of various processes including washing, chopping, pasteurising, freezing, fermenting, packaging, cooking and many more.² **Food processing also includes adding ingredients to food**, for example to extend shelf life.^{3, 4}

- ¹ Monteiro C, Levy R, Claro R, et al. (2010). A new classification of foods based on the extent and purpose of their processing. Cad Saude Publica 26(11), pp. 2039-2049.
- ² Floros J, Newsome R, Fisher W, et al. (2010). Feeding the world today and tomorrow: the importance of food science and technology. Comprehensive Reviews in Food Science and Food Safety 9(5), pp. 572–599.
- ³ Dwyer J, Fulgoni V, Clemens R, et al. (2012). Is 'Processed' a four-letter word? The role of processed foods in achieving dietary guidelines and nutrients recommendations. American Society for Nutrition 3, pp. 536-548.
- ⁴ Weaver C, Dwyer J, Fulgoni V, et al. (2014). Processed food: contributions to nutrition. The American Journal of Clinical Nutrition (AJCN) 99(6), pp. 1525-1542.

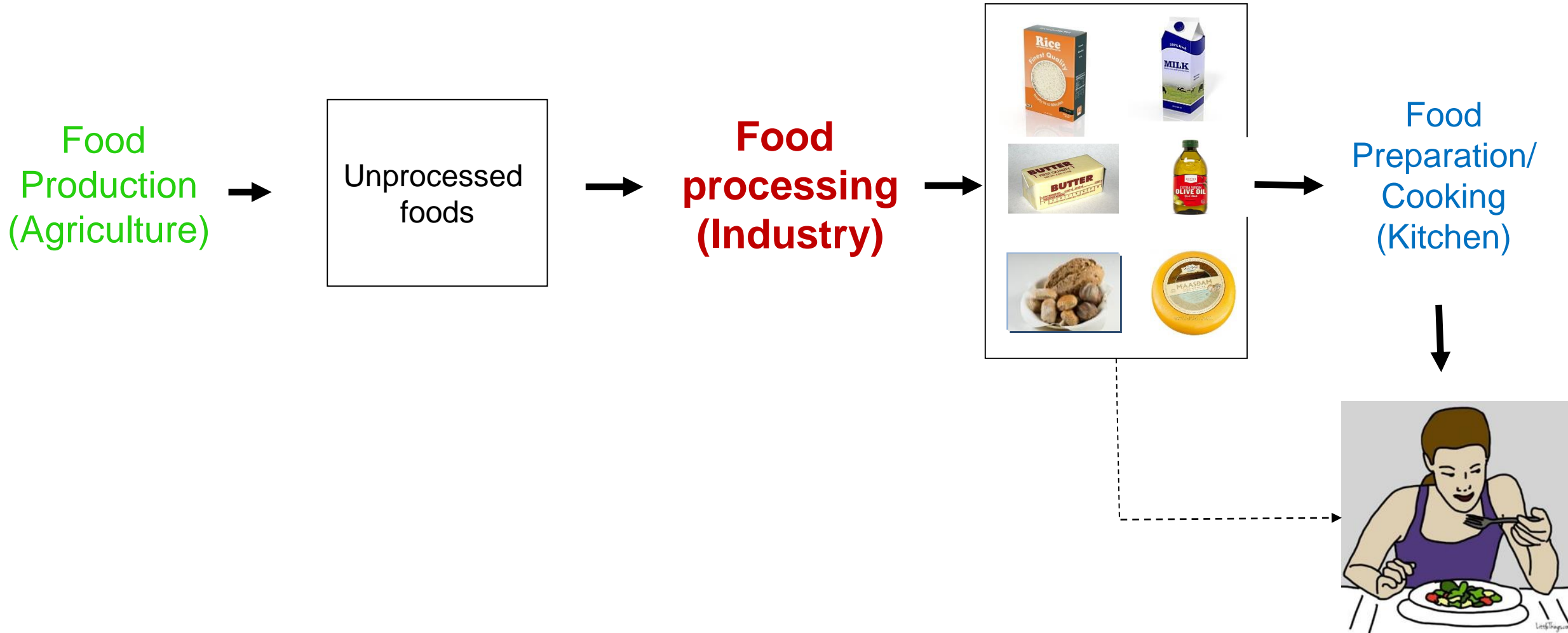
Food processing within the food system



Only a few foods are not processed before being prepared or consumed



Foods are processed in different ways and with different purposes



NOVA: a food classification based on **extent** and **purpose** of industrial processing

NOVA groups

Examples

1) Fresh or minimally processed foods

Edible parts of plants and animals after separation from nature or modified/preserved by minimal industrial processes (no substances added)



2) Processed culinary ingredients

Substances industrially obtained from Group 1 foods (or nature) and used to prepare, cook and season these foods (oils, fats, sugar, honey, salt)



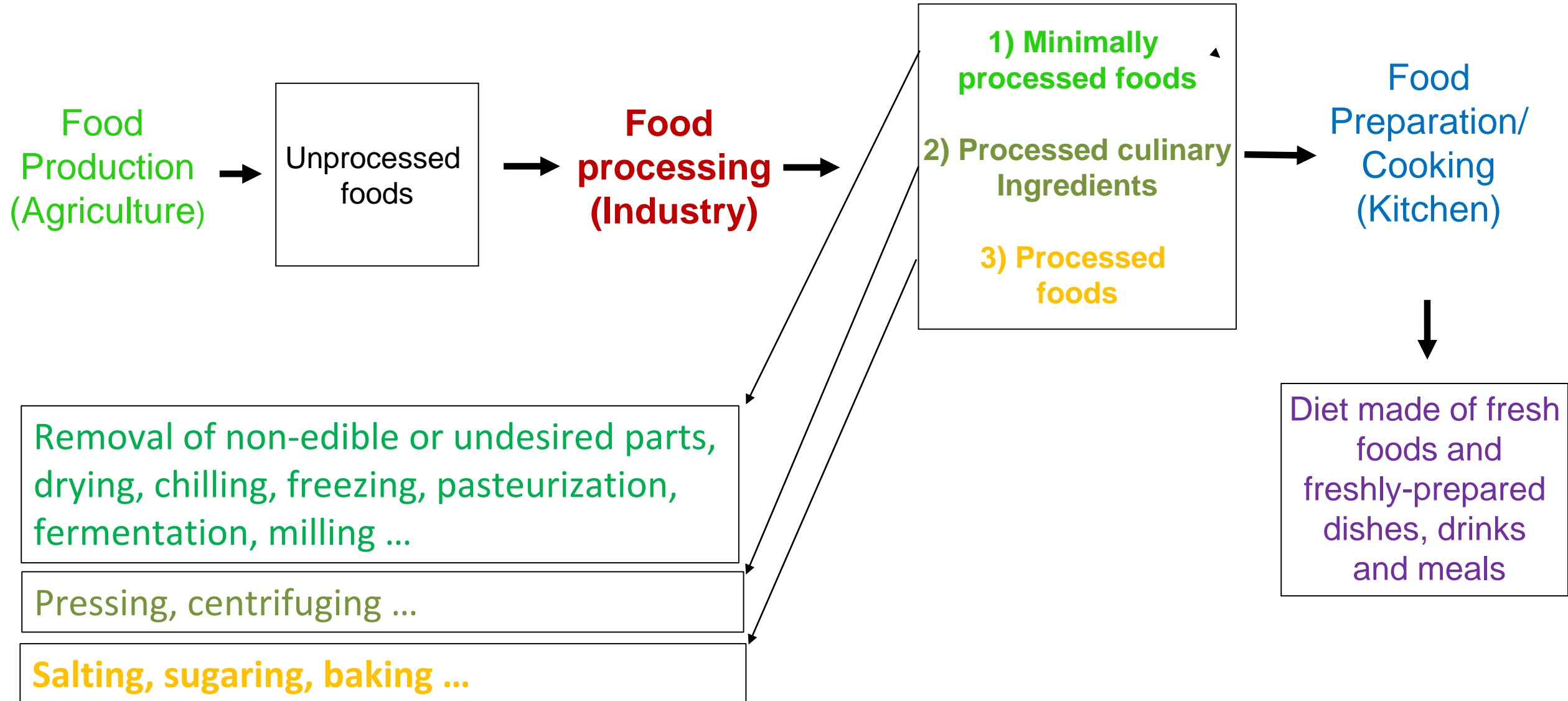
3) Processed foods

Group 1 foods modified by the industry with the addition of salt, sugar, oils or fats to preserve them and enhance their sensory qualities

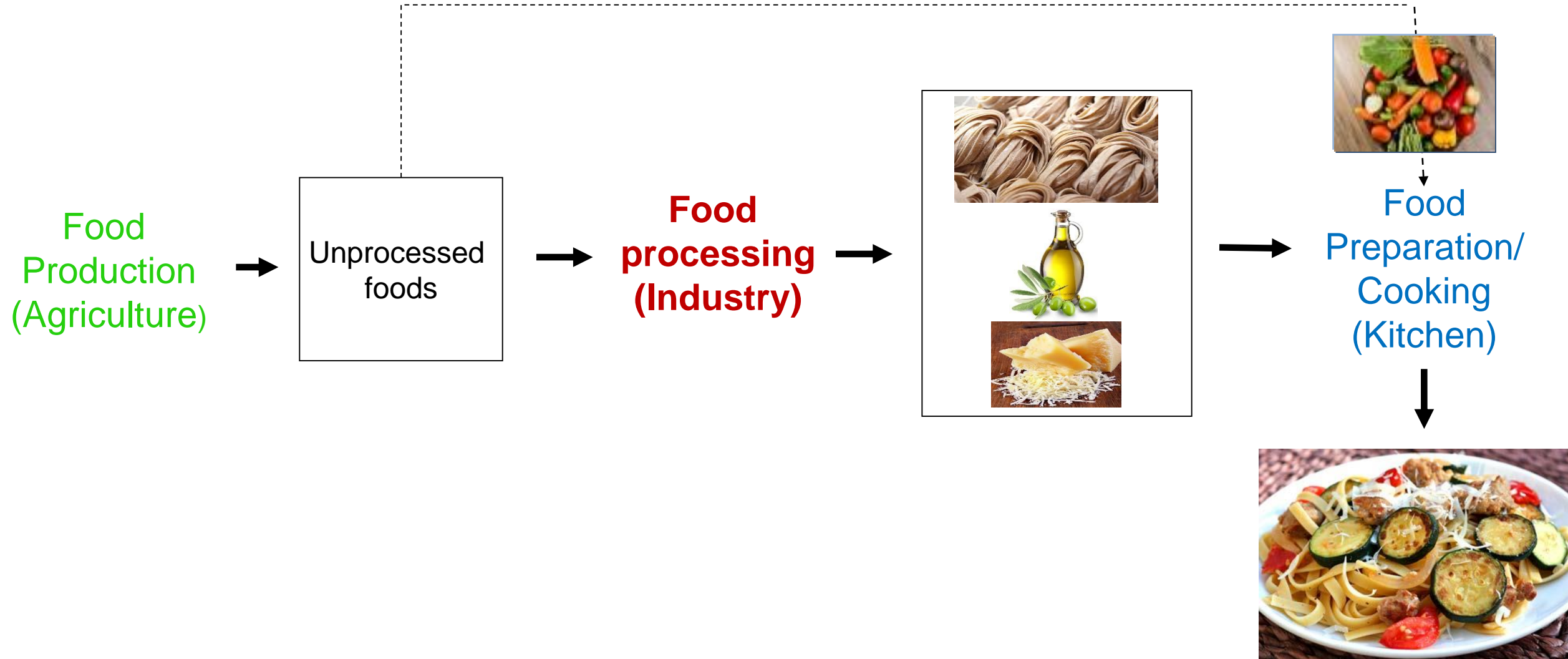


4) Ultra-processed foods

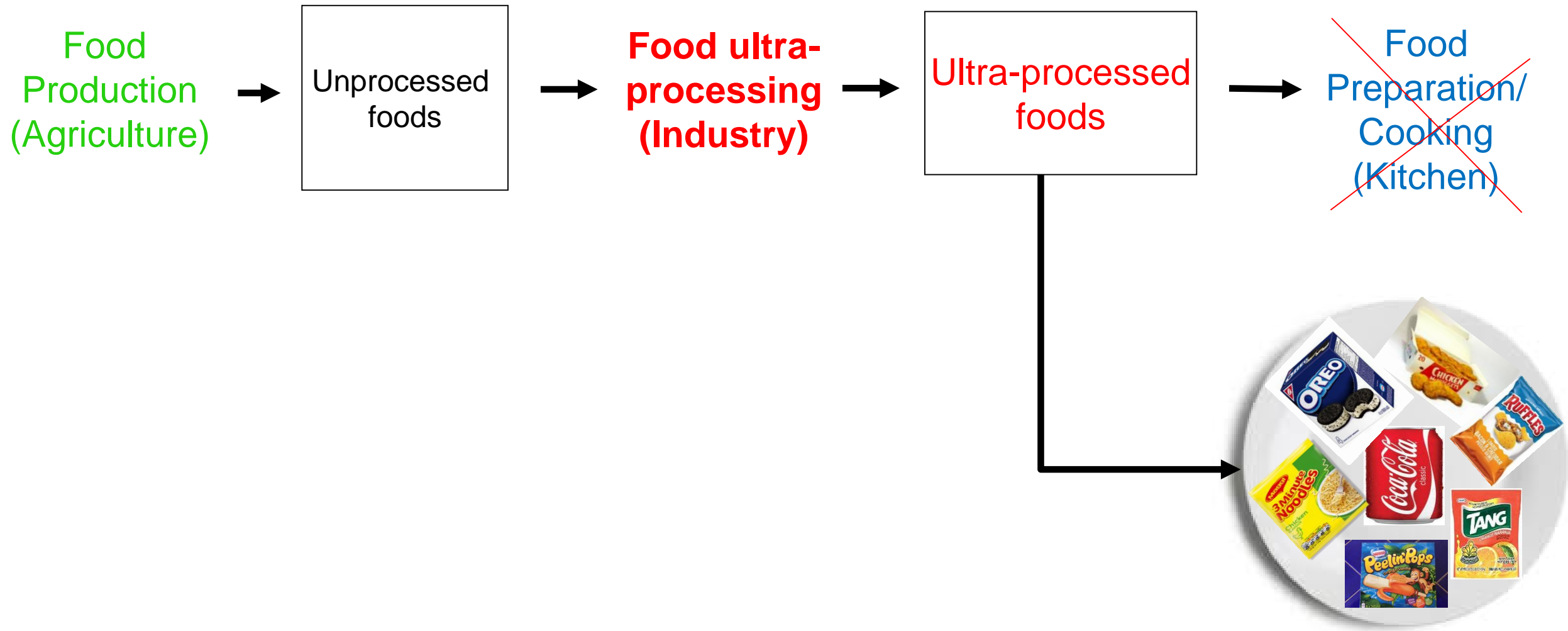
What are the processes involved?



Most traditional dietary patterns are based on freshly-prepared dishes and meals based on a mix of Nova groups 1, 2 and 3.



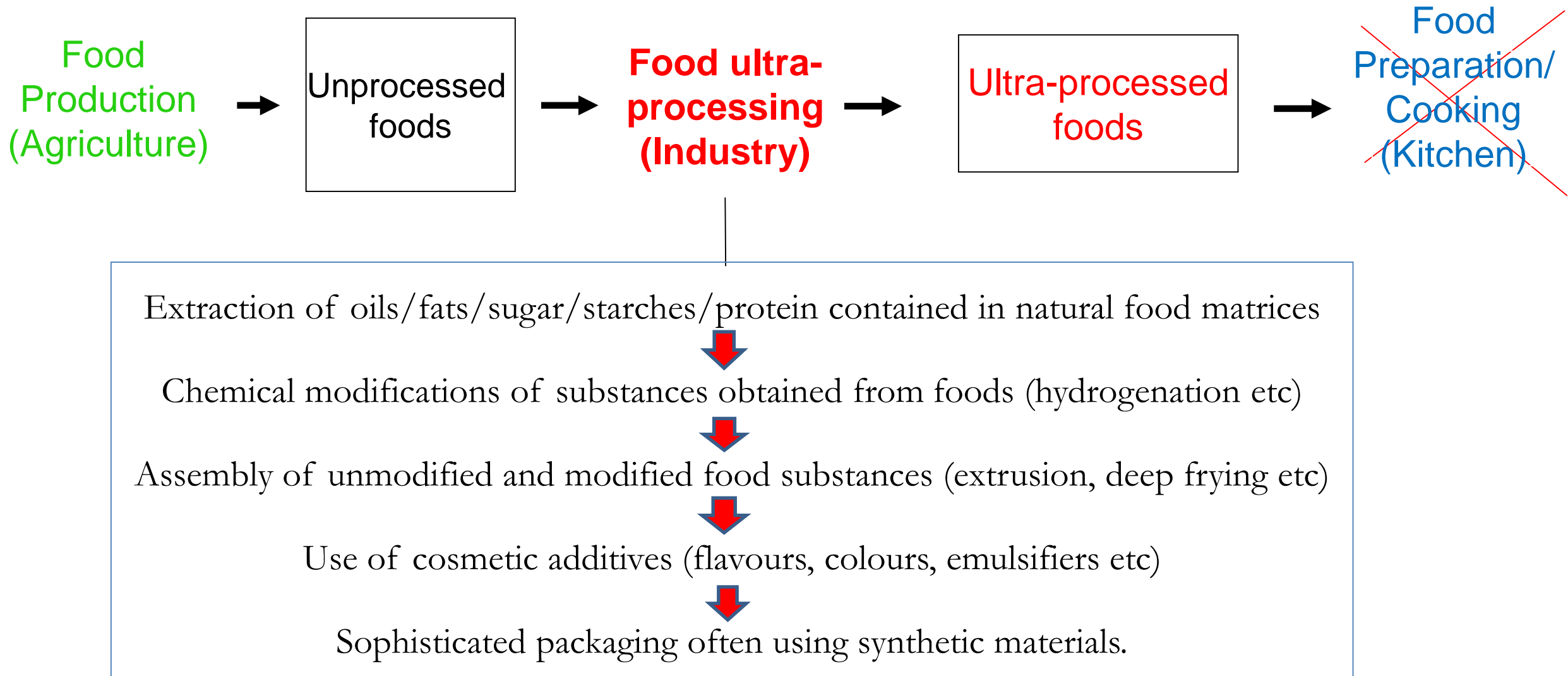
Another purpose of food processing is to make convenient (ready-to-eat, imperishable), tasteful, low cost (highly profitable) products liable to replace all other foods




Ultra-processed foods are manufactured and marketed to replace fresh/
minimally processed/processed foods and their culinary preparations
(And to make huge profits!)



What are the processes involved?



NOVA: a food classification based on **extent** and **purpose** of industrial processing

NOVA groups	Examples
1) Fresh or minimally processed foods	
2) Processed culinary ingredients	
3) Processed foods	
<div data-bbox="17 1039 611 1096">4) Ultra-processed foods</div> <div data-bbox="17 1110 1442 1382">Industrial formulations made by deconstructing natural food into its chemical constituents, modifying them and recombining them with a myriad of additives into convenient (durable, ready-to-consume), tasteful (often hyper-palatable) and highly profitable products (low cost ingredients) liable to replace all other NOVA food groups.</div>	<div data-bbox="1523 1039 2509 1402"></div>

Ultra-processed food: easily identified by its list of ingredients



Ingredients: salt, plant fats, starch, sugar, garlic, meat, pepper, flavor enhancer sodium monoglutamate, flavors, colors caramel and natural urucum, citric acid.



Ingredients: sugar, corn flour, wheat flour, oat flour, hydrogenated fat, salt, ascorbic acid, zinc oxide, niacin, iron, retinol palmitate, piridoxin, riboflavina, thiamin, folic acid, cobalamin, colors, flavors.



Ingredients: wheat flour, sugar, plant fats, salt, gluten, milk whey, calcium propionate, lecithin, calcium lactate, ascorbic acid.



Ingredients: sugar, maltodextrin, dehydrated orange pulp, iron, vitamin C, vitamin A, ascorbic acid, anti-humectant, calcium phosphate, gum shantan, flavors, aspartame, sodium cyclamate, potassium acesulfame, saccharine, colors. IT CONTAINS 1% OF DEHYDRATED ORANGE PULP

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Commentary

Ultra-processed foods: what they are and how to identify them

Carlos A Monteiro^{1,2,*}, Geoffrey Cannon², Renata B Levy^{2,3}, Jean-Claude Moubarac⁴, Maria LC Louzada², Fernanda Rauber², Neha Khandpur², Gustavo Cediel², Daniela Neri², Euridice Martinez-Steele², Larissa G Baraldi² and Patricia C Jaime^{1,2}

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Submitted 3 September 2018; Final revision received 21 November 2018; Accepted 30 November 2018; First published online 12 February 2019

Abstract

The present commentary contains a clear and simple guide designed to identify ultra-processed foods. It responds to the growing interest in ultra-processed foods

**UPF
markers**

- Food substances never or rarely used in kitchens

(protein isolates, gluten, casein, whey protein, 'mechanically separated meat', high-fructose corn syrup, 'fruit juice concentrate', invert sugar, maltodextrin, dextrose, lactose, soluble or insoluble fibre, hydrogenated or interesterified oil)

- Cosmetic additives

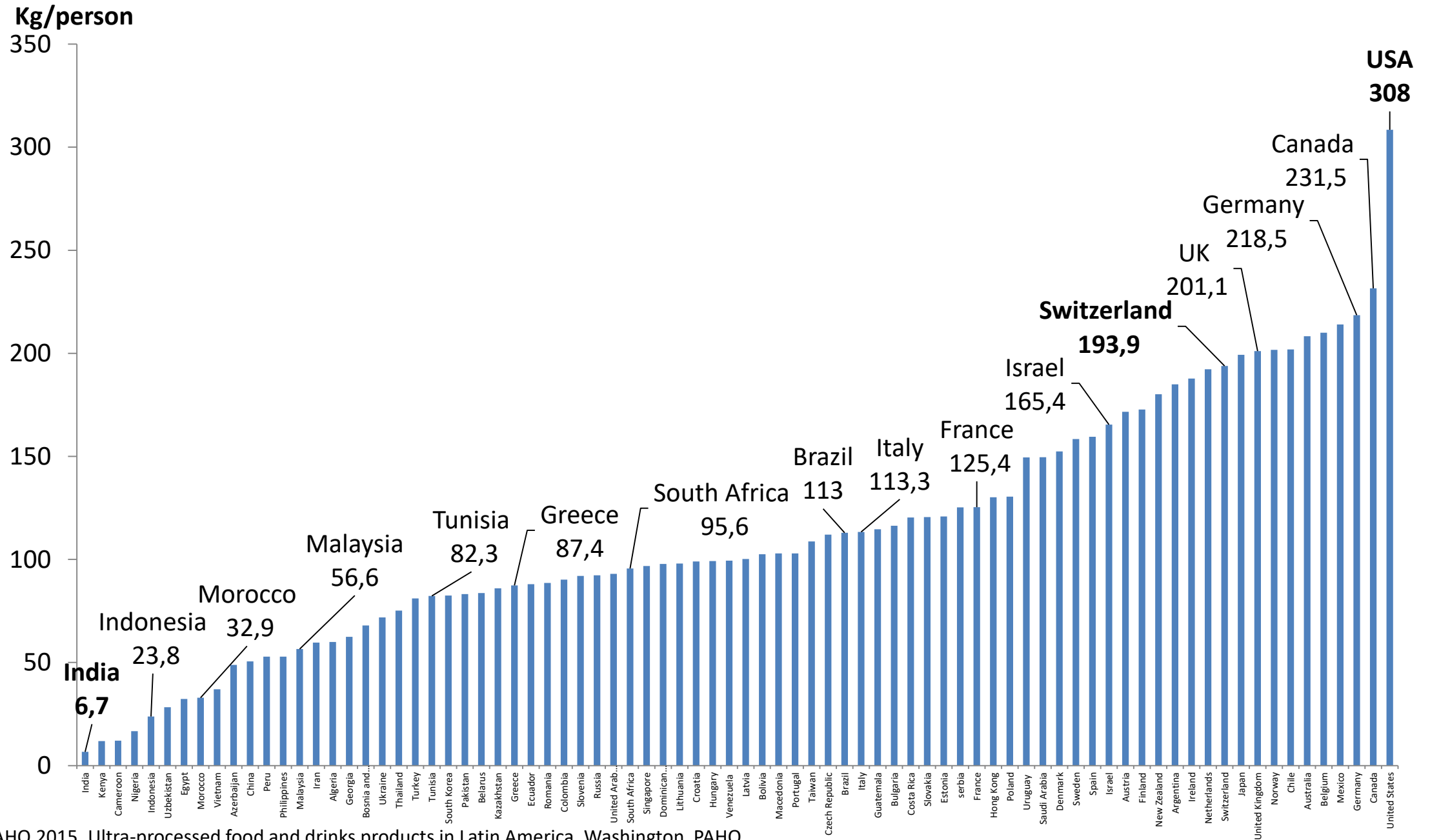
(flavors, flavor enhancers, colors, emulsifiers, sweeteners, thickeners, and anti-foaming, bulking, carbonating, foaming, gelling and glazing agents)

Top 10 manufacturers of packaged foods

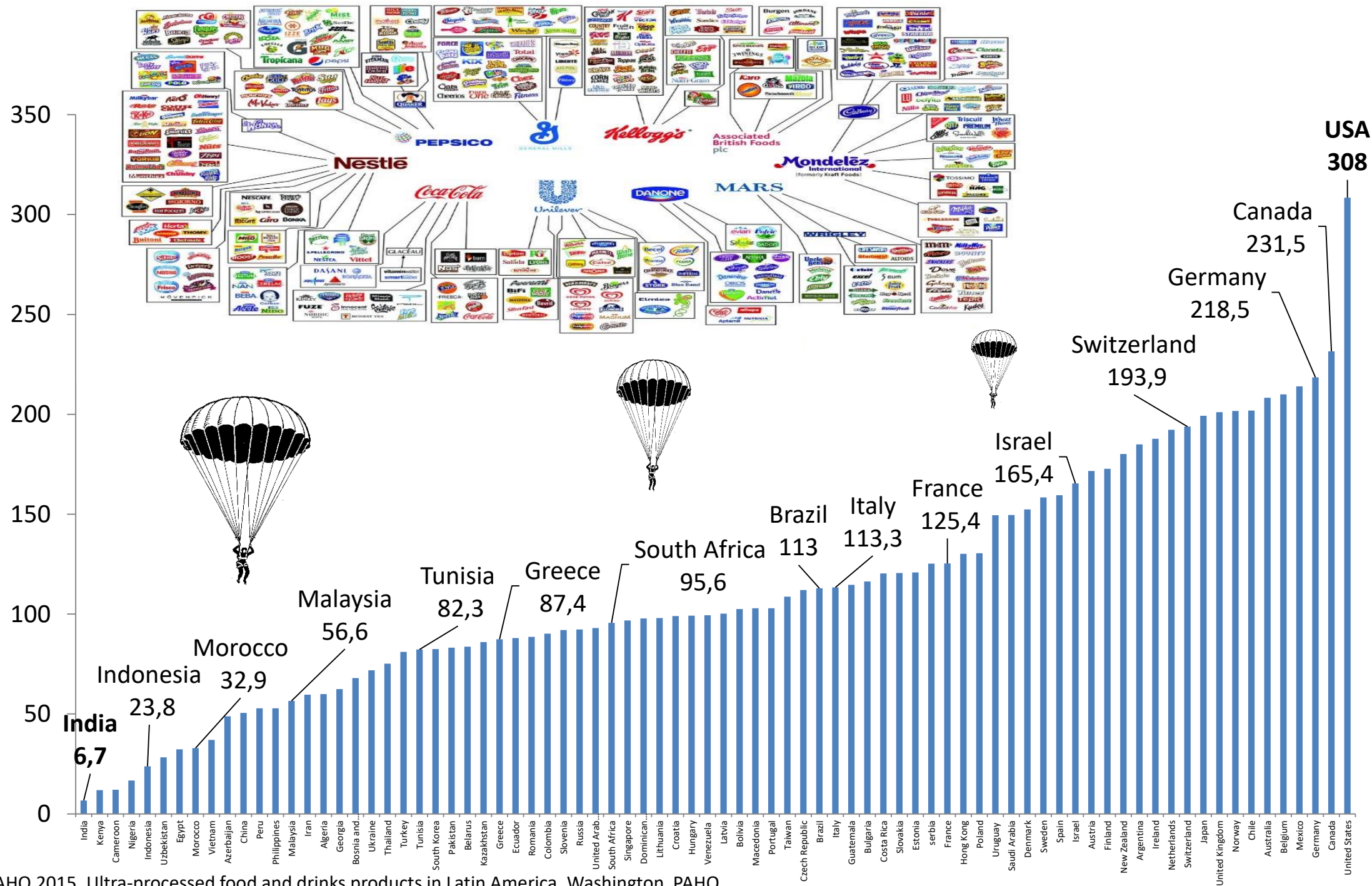
Brazil		China		India		Mexico		Russia		South Africa		USA	
Company	%	Company	%	Company	%	Company	%	Company	%	Company	%	Company	%
Nestlé SA	8.4	China Mengniu Dairy Co Ltd	4.9	Gujarat Co-operative Milk Marketing Federation Ltd	7.9	Grupo Bimbo SAB de CV	9.1	Wimm-Bill-Dann Produkty Pitania OAO	4.7	Tiger Brands Ltd	19.5	Kraft Foods Inc	6.8
Brf Brasil Foods SA	5.0	Inner Mongolia Yili Industrial Group Co Ltd	4.7	Britannia Industries Ltd	5.0	PepsiCo Inc	5.3	Danone, Groupe	4.3	Pioneer Food Group Ltd	6.3	PepsiCo Inc	5.2
Kraft Foods Inc	3.9	Kuok Oils & Grains Pte Ltd (KOG)	3.5	Nestlé SA	4.9	Nestlé SA	3.8	Nestlé SA	2.8	Nestlé SA	4.7	Nestlé SA	4.2
Unilever Group	3.3	Ting Hsin International Group	3.1	National Dairy Development Board	4.8	Industrial Lala SA de CV, Grupo	3.6	Obiedinenye Konditery UK OOO	2.3	Clover Ltd	4.7	Mars Inc	3.2
Groupe Danone	2.8	Shineway Group	2.9	Parle Products Pvt Ltd	4.8	Kraft Foods Inc	2.8	Mars Inc	2.1	Parmalat Group	4.6	Kellogg Co	2.7
PepsiCo Inc	2.5	Hangzhou Wahaha Group	2.2	Kraft Foods Inc	3.1	Ganaderos Productores de Leche Pura SA	2.1	Kraft Foods Inc	1.7	Unilever Group	4.4	General Mills Inc	2.7
Bunge Ltd	2.0	Want Want Group	2.0	Karnataka Cooperative Milk Producers Federation Ltd	2.8	Sigma Alimentos SA de CV	1.8	Unilever Group	1.2	Dairybelle (Pty) Ltd	4.0	Hershey Co, The	2.3
M Dias Branco SA Indústria e Comércio de Alimentos	1.7	Bright Food (Group) Co Ltd	1.6	GlaxoSmithKline Plc	2.7	Kellogg Co	1.7	Valio Oy	1.1	Kraft Foods Inc	3.4	ConAgra Foods Inc	2.1
Private Label	1.6	China National Cereals, Oils & Foodstuffs Imp & Exp Corp (COFCO)	1.4	ITC Group	2.4	Unilever Group	1.7	Cherkizovsky APK	0.9	AVI Ltd	3.3	Unilever Group	2.0
Itambé SA	1.5	Mars Inc	1.3	PepsiCo Inc	2.3	Conservas La Costeña SA	1.1	Yug Rusi APG	0.9	PepsiCo Inc	2.4	Campbell Soup Co	1.6

Stuckler D, McKee M, Ebrahim S, Basu S (2012) Manufacturing Epidemics: The Role of Global Producers in Increased Consumption of Unhealthy Commodities Including Processed Foods, Alcohol, and Tobacco. PLOS Medicine 9(6): e1001235.

Annual retail sales of ultra-processed food and drink products in 80 countries (2013)



Source : PAHO 2015. Ultra-processed food and drinks products in Latin America. Washington, PAHO.



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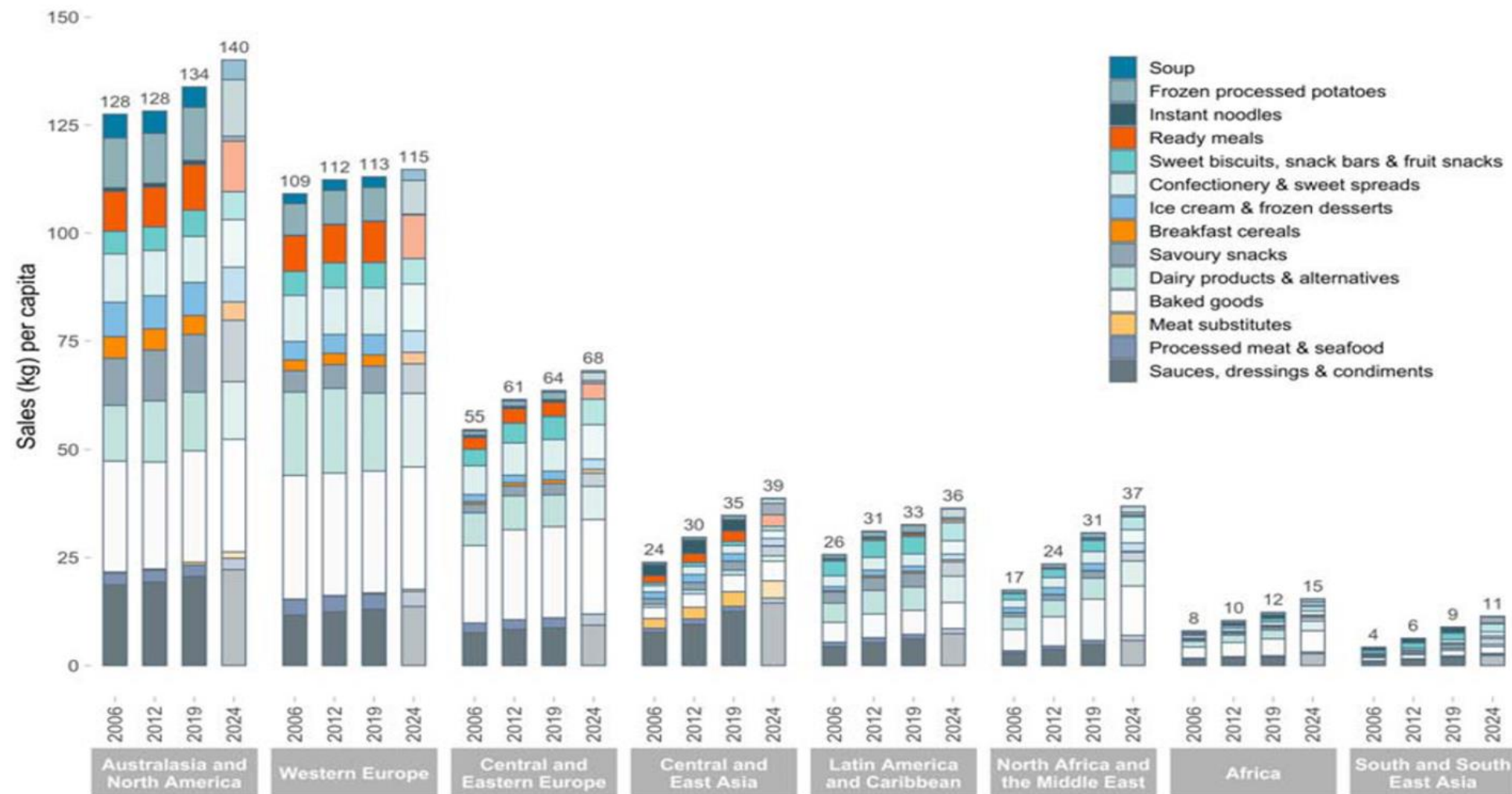
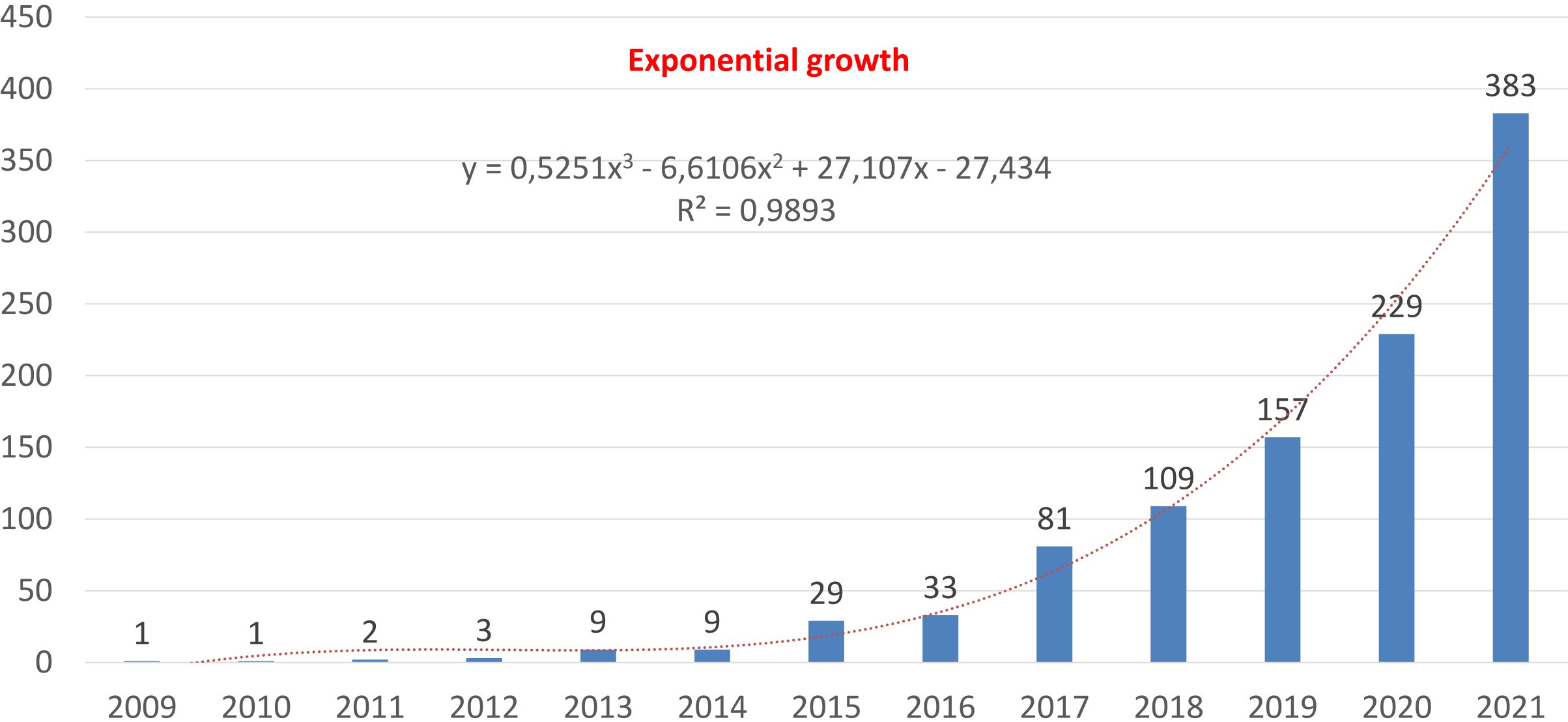


FIGURE 1 Ultra-processed foods sales (kg) per capita by region, 2006–2019 with projections to 2024

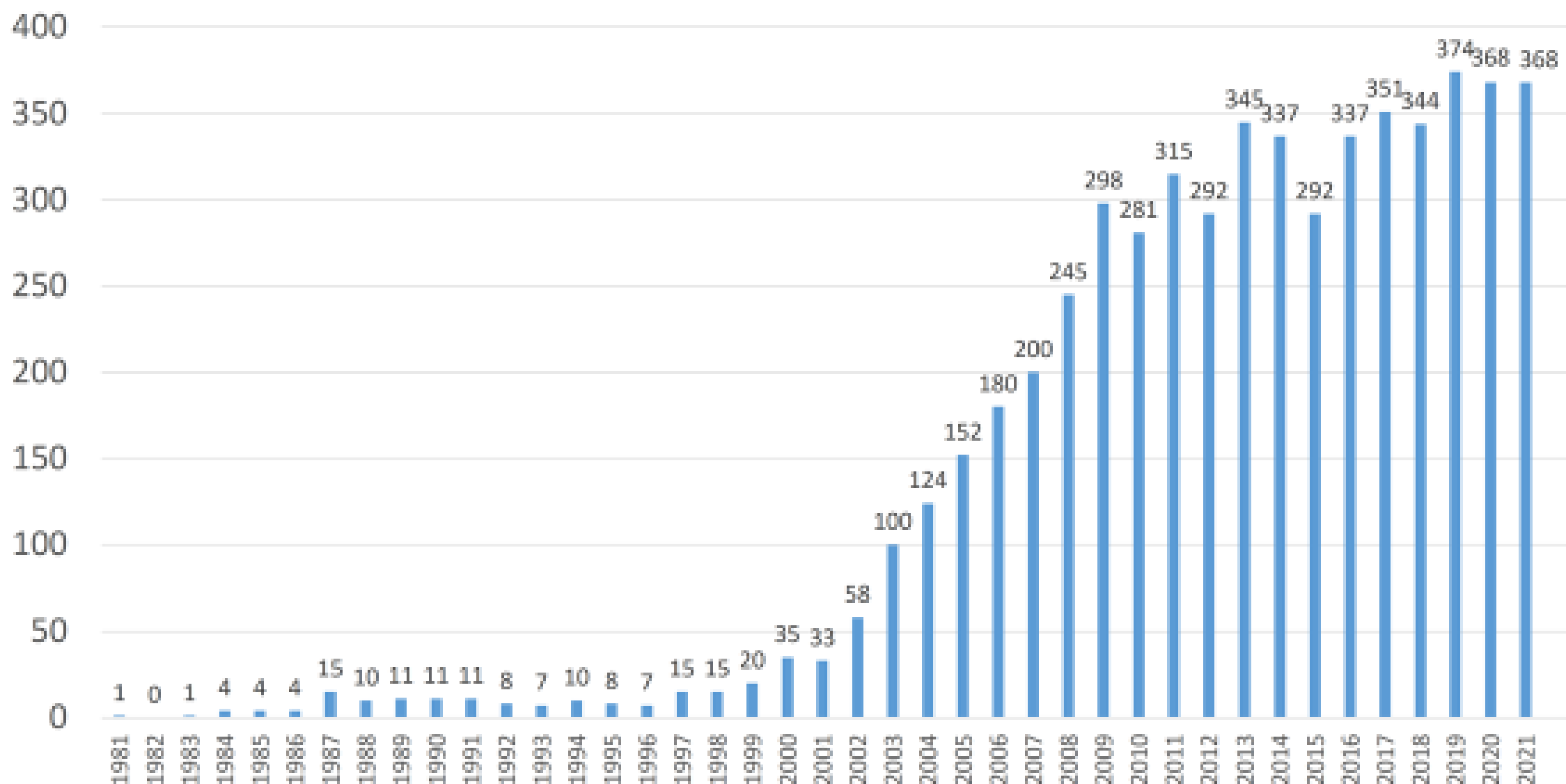
The NOVA food classification system

- Rationale
- Description
- Uses and applications:
 - Description of food processing-based dietary patterns
 - Effect of food processing-based dietary patterns on diet quality and disease
 - Development of dietary recommendations (National Dietary Guidelines)
 - Policy and program goals and regulations
- Developments/improvements

960 papers in PubMed with the term ‘ultra-processed’



4951 papers in PubMed with the term “glycemic index”

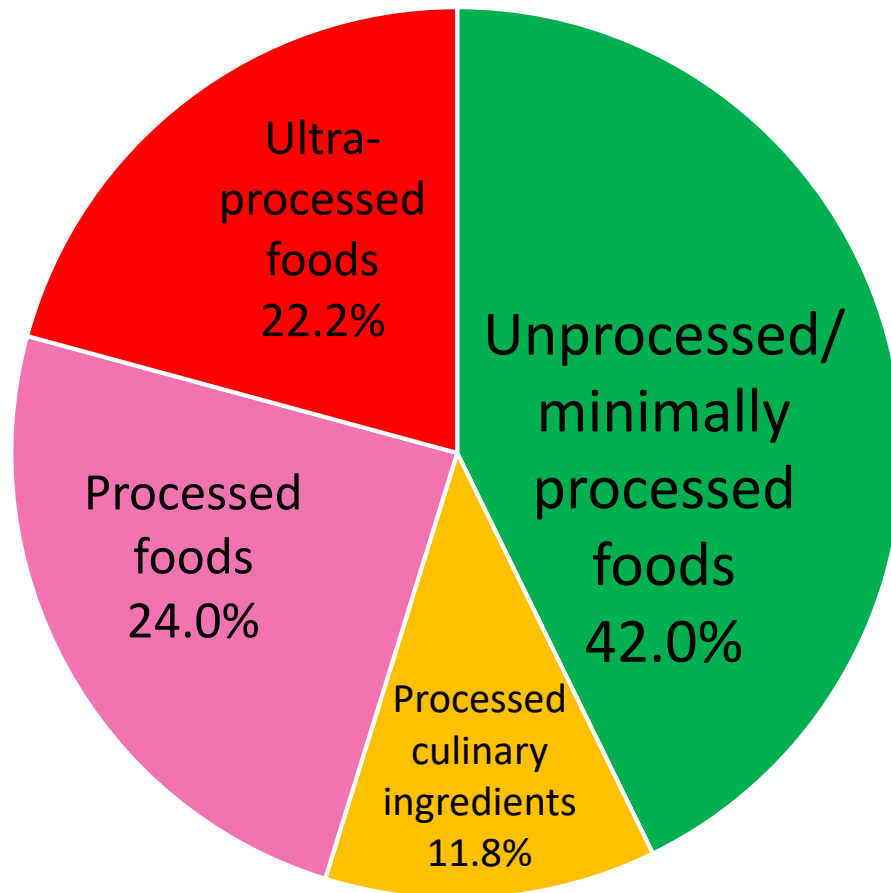


The NOVA food classification system

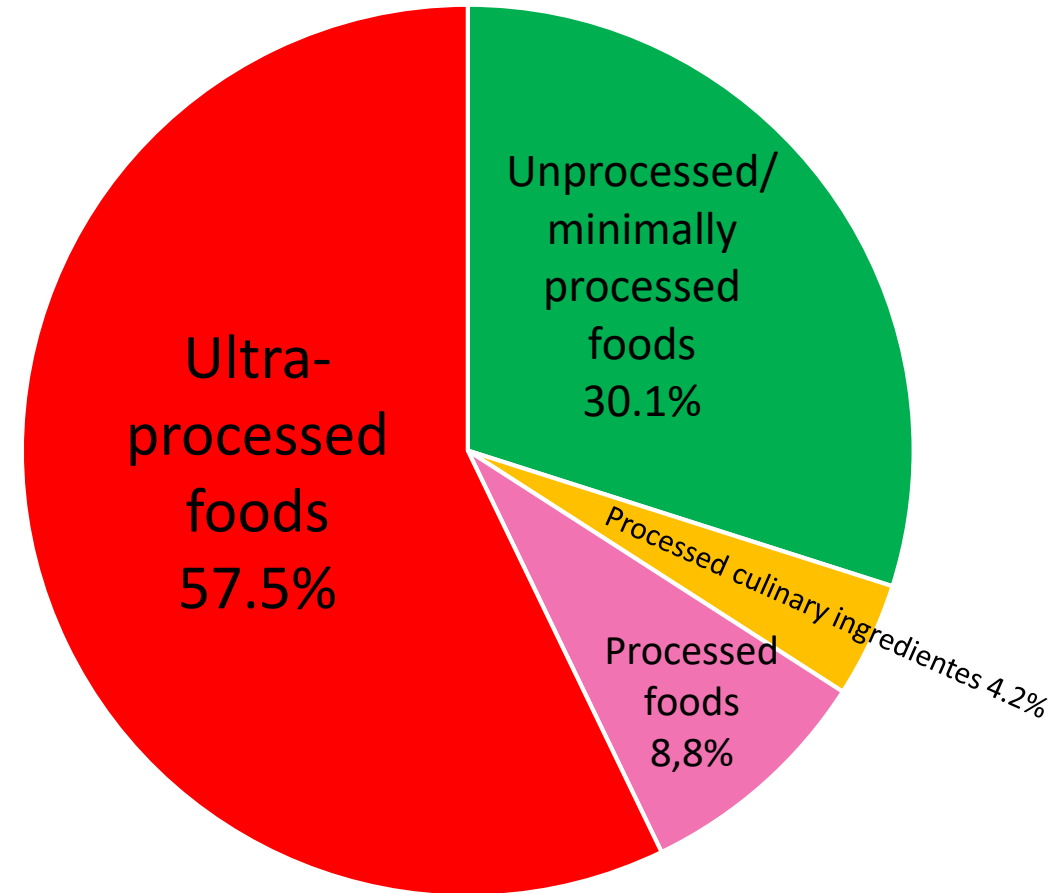
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Distribution (%) of total energy intake according to NOVA food groups

PORTUGAL 2014/5

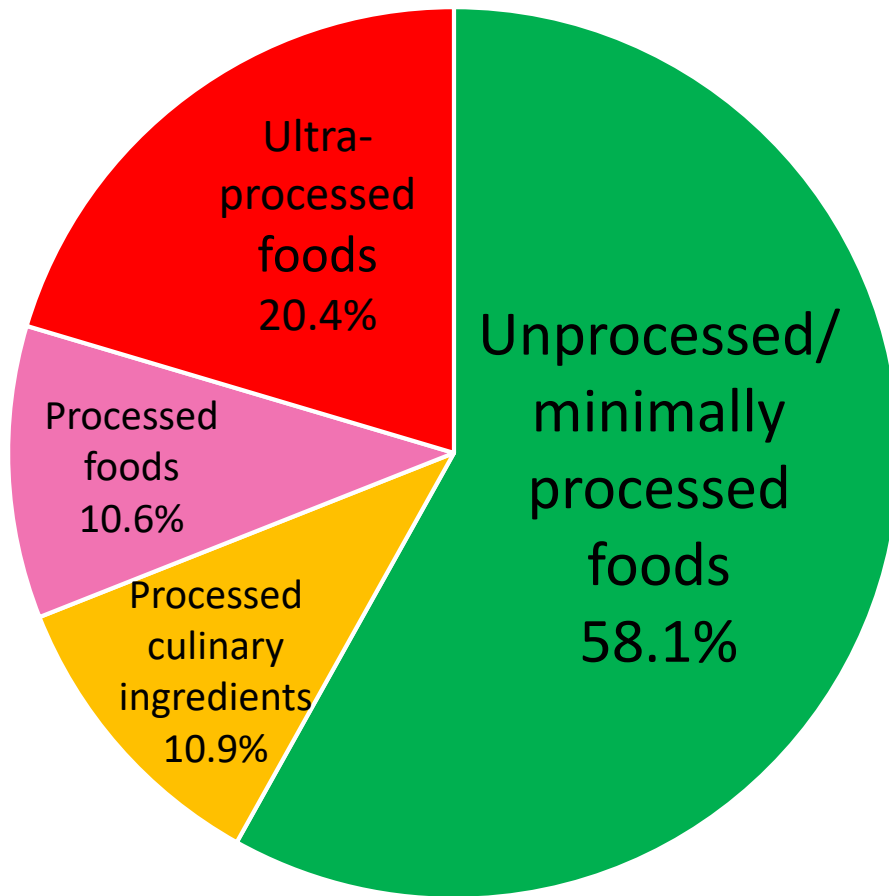


UK 2008/14

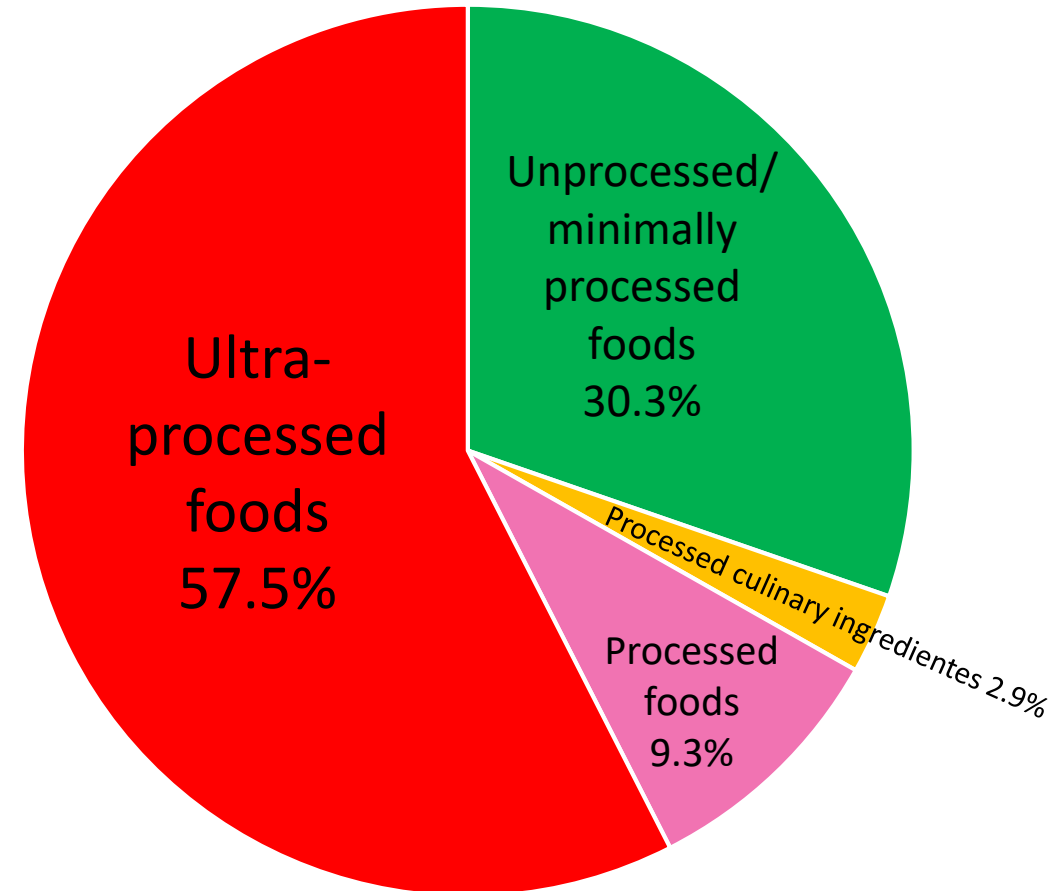


Distribution (%) of total energy intake according to NOVA food groups

BRAZIL 2008/9



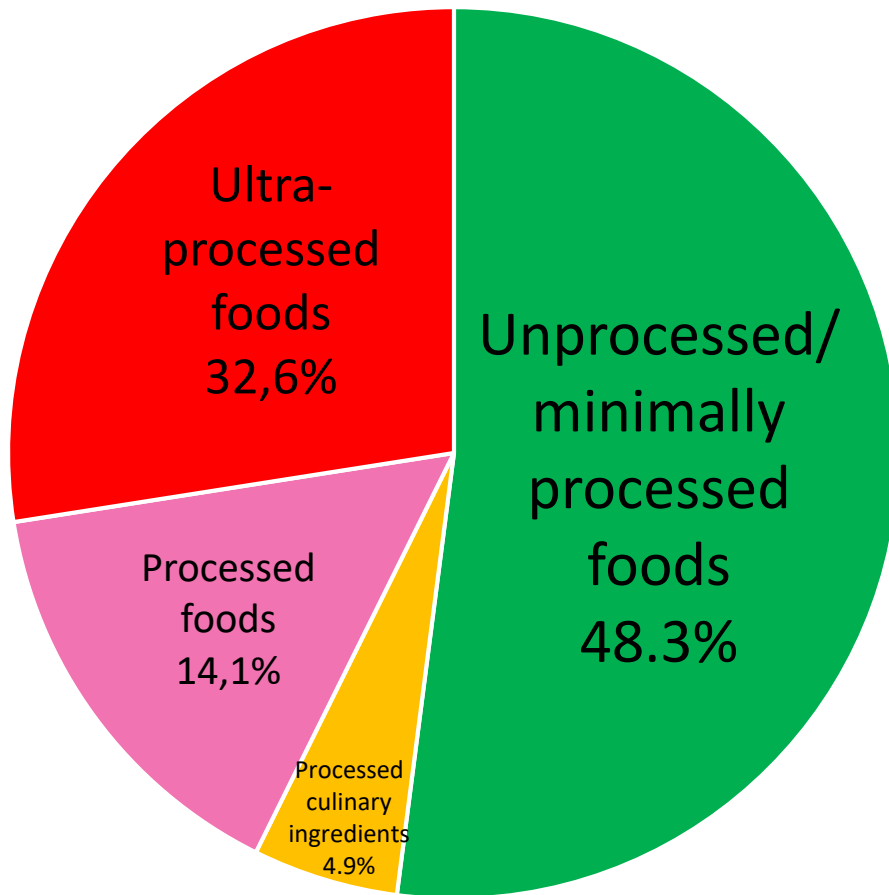
US 2009/10



Distribution (%) of total energy intake according to NOVA food groups

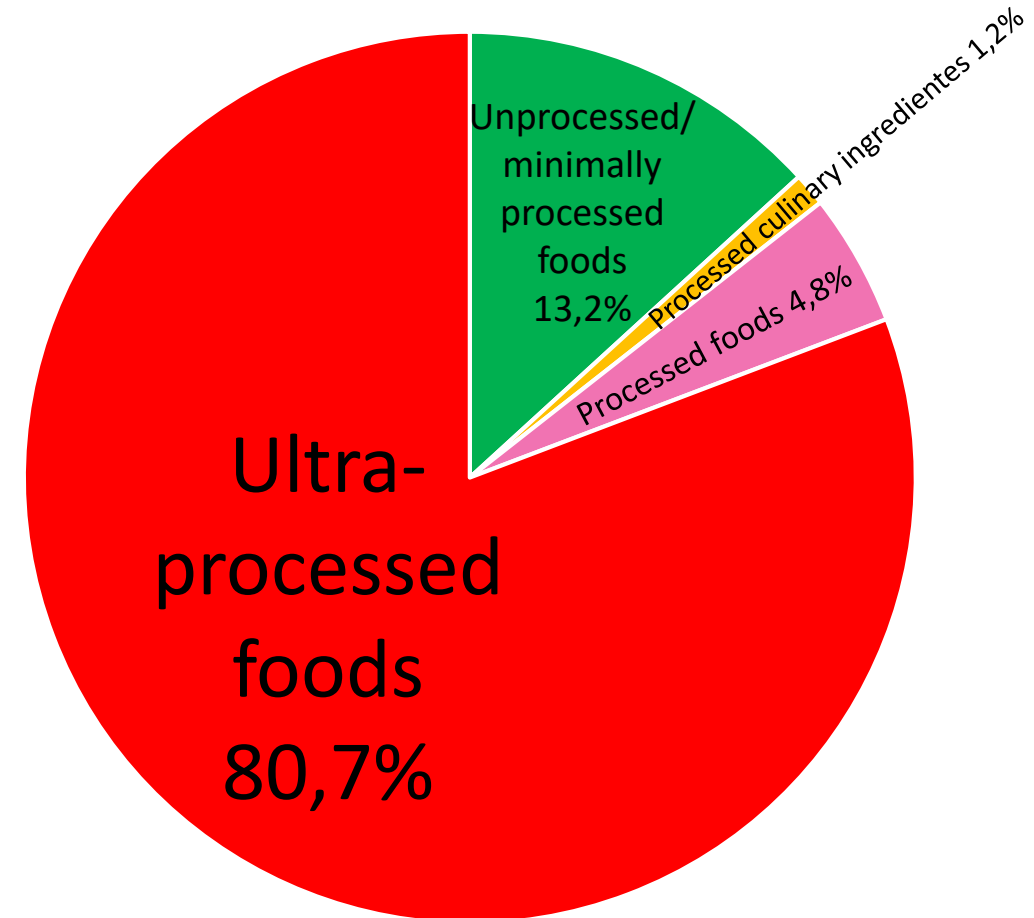
US 2009/10

The 20% with lower UPF consumption



US 2009/10

The 20% with higher UPF consumption



The NOVA food classification system

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Ultra-processed food intake and diet quality:

a) UPF impact on the dietary nutrient profile



X





Review

Ultra-Processed Foods and Nutritional Dietary Profile: A Meta-Analysis of Nationally Representative Samples

Daniela Martini ^{1,†} , Justyna Godos ^{2,*,†} , Marialaura Bonaccio ³ , Paola Vitaglione ⁴  and Giuseppe Grosso ² 

¹ Department of Food, Environmental, and Nutritional Sciences, Università degli Studi di Milano, 20133 Milan, Italy; daniela.martini@unimi.it

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³ Department of Epidemiology and Prevention, IRCCS NEUROMED, 86077 Pozzilli, Italy; marialaura.bonaccio@moli-sani.org

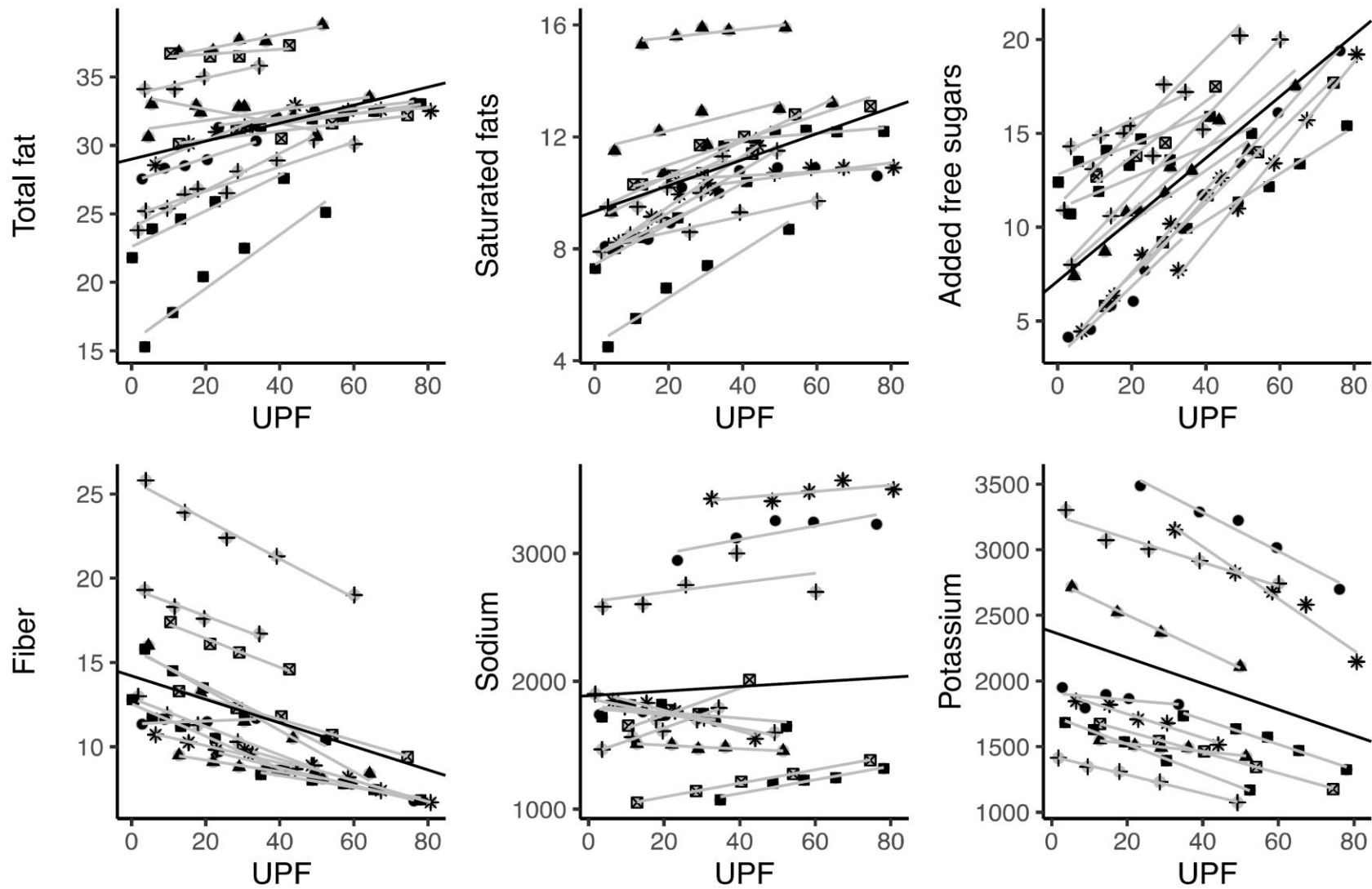
⁴ Department of Agricultural Sciences, University of Naples Federico II, 80055 Portici, Italy; paola.vitaglione@unina.it

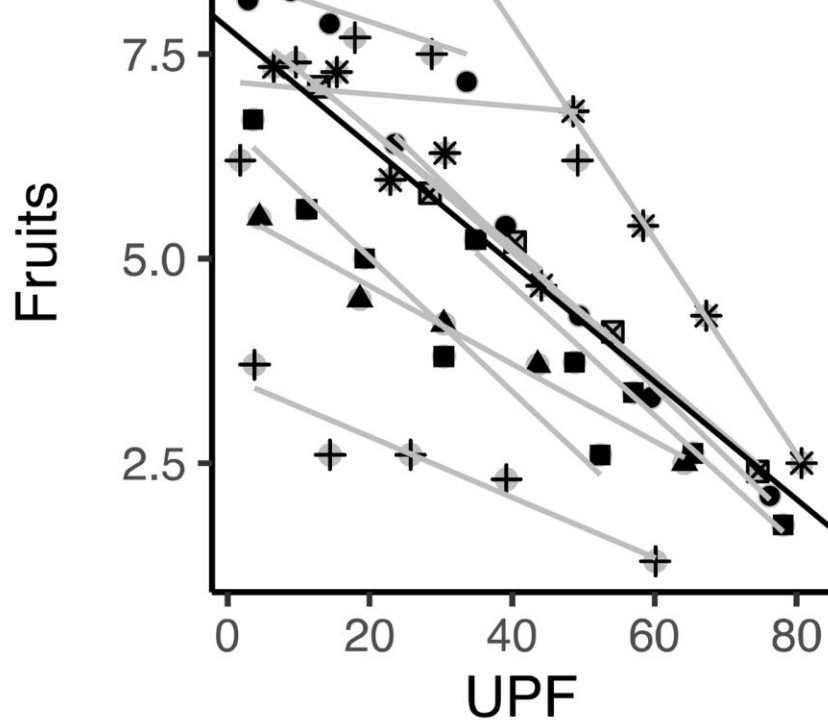
* Correspondence: justyna.godos@gmail.com; Tel./Fax: +39-0954781187

† These authors contributed equally to this work.

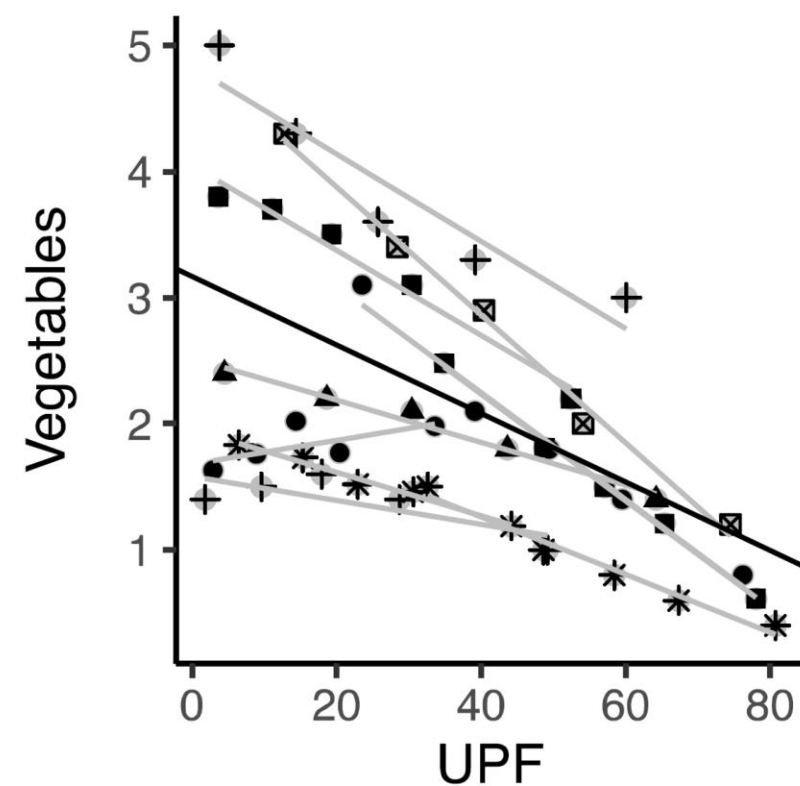
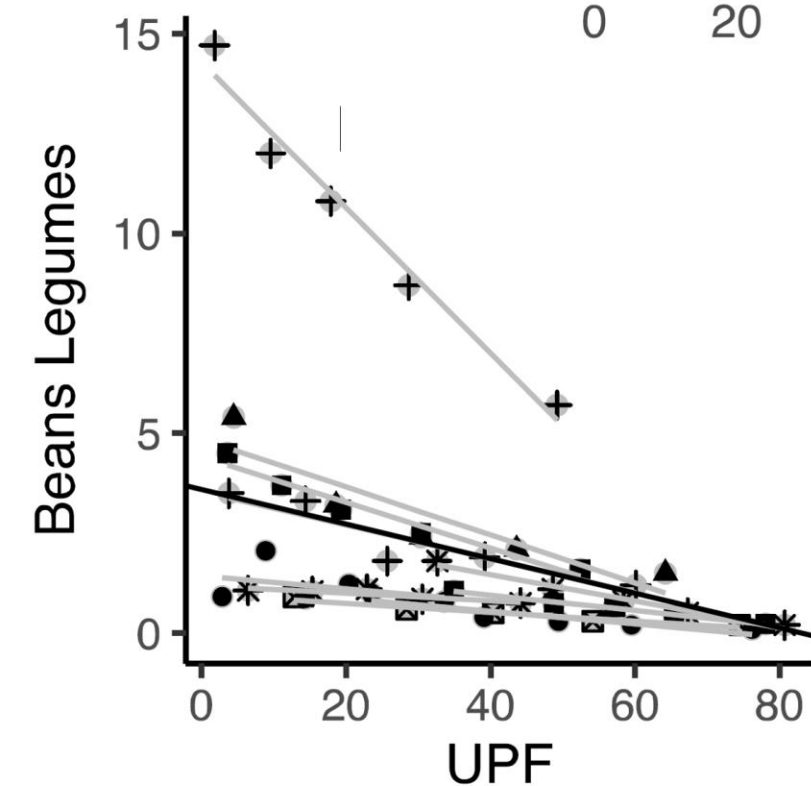
Meta-analysis of data from 13 countries (Australia, Brazil, Canada, Chile, Colombia, France, Italy, Korea, Mexico, Portugal, Taiwan, the UK and the USA) shows that increases in consumption of

MORE UPF IN THE DIET LEADS TO HIGHER ENERGY INTAKE, MORE SATURATED FAT, AND FREE SUGARS AND LESS PROTEIN, FIBER, VIT A, C, E, B12, NIACIN, PHOSPHORUS, ZINC, AND MAGNESIUM





UPFs displace health-protective un/minimally processed foods



SUPPLEMENT ARTICLE

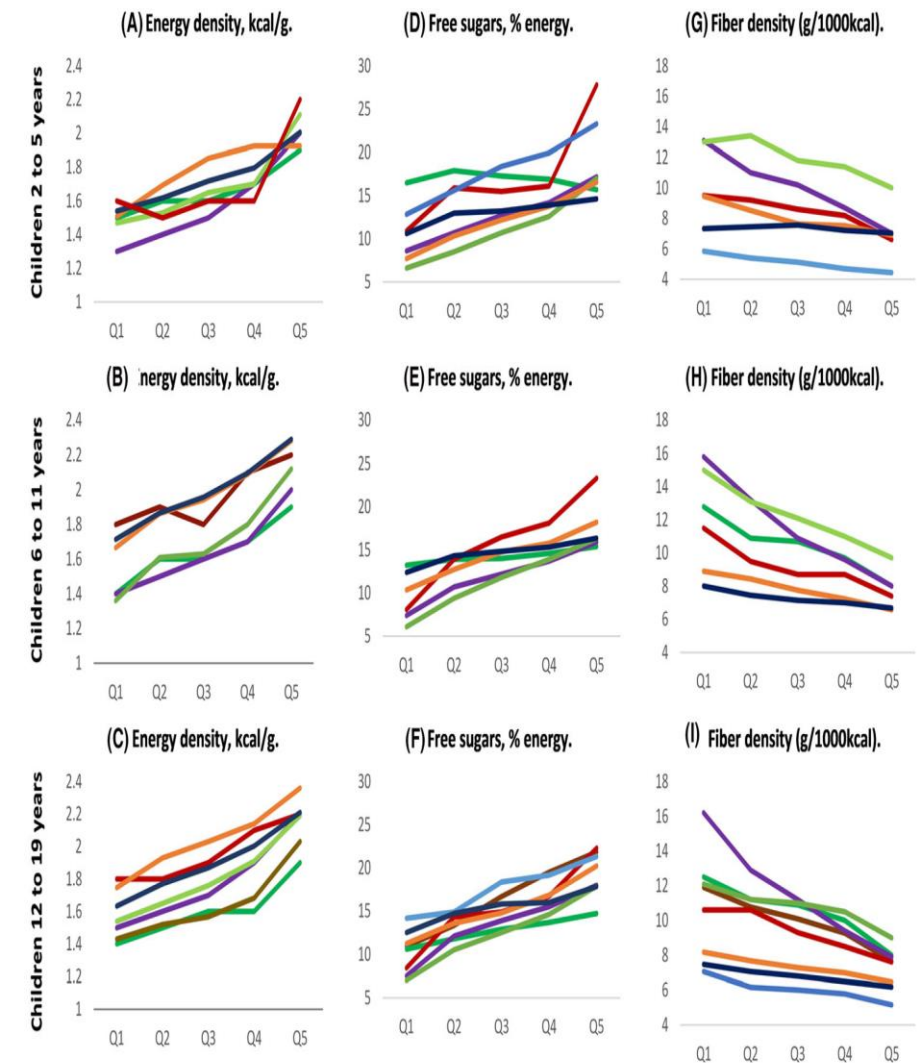
Ultraprocessed food consumption and dietary nutrient profiles associated with obesity: A multicountry study of children and adolescents

Daniela Neri^{1,2} | Eurídice Martínez Steele^{1,2} | Neha Khandpur^{1,2} |
Gustavo Cediel³ | Maria Elisa Zapata⁴ | Fernanda Rauber^{1,2} |
Joaquín A. Marrón-Ponce⁵ | Priscila Machado⁶ | Maria Laura da Costa Louzada^{1,2} |
Giovanna Calixto Andrade^{1,2} | Carolina Batis⁵ | Nancy Babio^{7,8} |
Jordi Salas-Salvado^{7,8} | Christopher Millett⁹ | Carlos Augusto Monteiro^{1,2} |
Renata Bertazzi Levy^{1,2,10} | for the NOVA Multi-Country Study Group on Ultra-Processed
Foods, Diet Quality and Human Health

¹Center for Epidemiological Research in Nutrition and Health, University of São Paulo, São Paulo, Brazil

²Department of Nutrition, School of Public Health, University of São Paulo, São Paulo, Brazil

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Brazil. Colombia. Argentina. Mexico. Chile. Australia. United Kingdom. United States.

FIGURE 2 (A) Mean dietary energy density, (B) mean content of free sugars, and (C) mean content of fiber across quintiles of the dietary share of ultraprocessed foods for each country and within the three age groups

Consumption of Ultraprocessed Foods and Diet Quality Among U.S. Children and Adults

Junxiu Liu, PhD,^{1,2} Euridice Martinez Steele, PhD,^{3,4} Yan Li, PhD,^{1,5} Dimitra Karageorgou, PhD,² Renata Micha, PhD,² Carlos A. Monteiro, PhD,^{3,4} Dariush Mozaffarian, MD, DrPH²

Analysis from NHANES 2015–2018 revealed a strong association between higher dietary share of UPF and poor-quality diets identified by the American Heart Association (AHA) diet score (extensively validated against diverse cardiovascular outcomes), or the Healthy Eating Index 2015 (which reflects adherence to key recommendations in the US DG). Across quintiles of UPF consumption, % of poor-quality diets (AHA score < 32 points) more than doubled among children (from 31.3% to 71.6%), and more than tripled among adults (from 18.1% to 59.7%).

Ultra-processed food intake and diet quality:

b) UPF impact on other health-related dietary attributes



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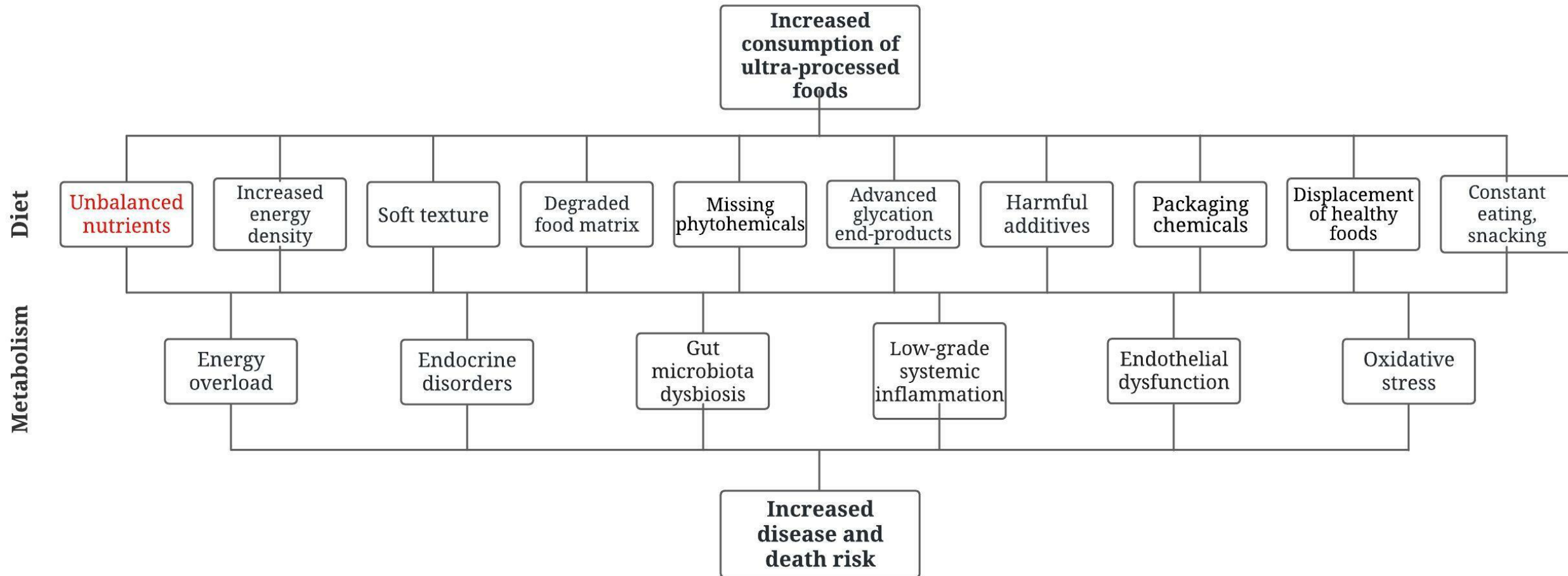


ultra-processed food intake and diet quality:

Higher dietary share of UPF is also linked to:

- Lack of bioactive non-nutrient compounds (Martinez-Steele & Monteiro 2018)
- Phthalates and Bisphenol A released from packaging materials (Martinez-Steele et al. 2020)
- Potentially harmful additives (Cox et al. 2020; He et al. 2021)
- Increased glycemic response (Fardet 2016)
- Increased palatability/quasi-addictive properties (Gearhardt 2021)
- Increased energy intake rate (Forde et al 2020)
- Reduced satiety (Fardet 2016, Dioneda et al 2020)
- Reduced thermic effect (Dioneda et al 2020)
- Reduced total water intake (Baraldi et al 2021)
- Increased pro-inflammatory microbiome (Zinocker & Lindseth 2018)

Dietary and metabolic mechanisms that plausibly explain why ultra-processed foods are liable to cause diseases



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Ten systematic reviews on UPF and health outcomes published in 2020/2021



Food consumption by degree of processing and cardiometabolic risk: a systematic review

Talitha Silva Meneguelli, Jéssica Viana Hinkelmann, Helen Hermana Miranda Hermsdorff, M. Angeles Zulet, J. Alfredo Martínez & Josefina Bressan

To cite this article: Talitha Silva Meneguelli, Jéssica Viana Hinkelmann, Helen Hermana Miranda Hermsdorff, M. Angeles Zulet, J. Alfredo Martínez & Josefina Bressan (2020) Food consumption by

International Journal of Obesity
<https://doi.org/10.1038/s41366-020-00650-z>

REVIEW ARTICLE

Epidemiology and Population Health

Ultra-processed food and the risk of overweight and obesity: a systematic review and meta-analysis of observational studies

Mohammadreza Askari¹ · Javad Heshmati² · Hossein Shahinfar³ · Nishant Tripathi³ · Elnaz

Received: 27 November 2019 / Revised: 1 July 2020 / Accepted: 5 August 2020
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Abstract

Background Numerous studies have reported the association of ultra-processed foods with excess body weight, the nature and extent of this relation has not been clearly established. This systematic review was conducted to



Chen et al. *Nutrition Journal* (2020) 19:86
<https://doi.org/10.1186/s12937-020-00604-1>

Nutrition Journal

REVIEW

Open Access

Consumption of ultra-processed foods and health outcomes: a systematic review of epidemiological studies

Xiaojuan Chen^{1,2†}, Zhang Zhang^{1,2†}, Huijie Yang^{1,2†}, Peishan Qiu^{1,2}, Haizhou Wang^{1,2}, Fan Wang^{1,2}, Qiu Zhao^{1,2*}, Jun Fang^{1,2} and Jijian Nie^{1,2}

Abstract

Background: Consumption of ultra-processed foods (UPFs) plays a potential role in the development of obesity and other non-communicable diseases (NCDs), but no studies have systematically reviewed on this. This

Received: 29 July 2020 | Revised: 26 August 2020 | Accepted: 3 September 2020
DOI: 10.1111/obr.13146

OBESITY/COMORBIDITIES/NUTRITION

Ultraprocessed food and chronic noncommunicable diseases: A systematic review and meta-analysis of 43 observational studies

Melissa M. Lane¹ | Jessica A. Davis¹ | Sally Beattie⁴ | Clara Gómez-Donoso^{2,3} | Amy Loughman¹ | Adrienne O'Neil¹ | Felice Jacka^{1,6,7,8} | Michael Berk^{1,9} | Richard Page^{1,4,5} | Wolfgang Marx¹ | Tetyana Rocks¹

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⁴The Barwon Centre of Orthopaedic Research and Education (B-CORE), Barwon Health and St John of God Hospital Geelong, Geelong, Victoria, Australia

⁵School of Medicine, Deakin University, Geelong, Victoria, Australia

⁶Centre for Adolescent Health, Murdoch Children's Research Institute, Melbourne, Victoria, Australia

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International Journal of Epidemiology, 2021, 1–22
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Original Article



Original Article

Ultra-processed food and risk of type 2 diabetes: a systematic review and meta-analysis of longitudinal studies

Felipe Mendes Delpino^{1,2*} · Lilian Munhoz Figueiredo³



Review

Ultra-Processed Foods and Health Outcomes: A Narrative Review

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Abstract: The nutrition literature and authoritative reports increasingly recognise the concept of



Revista de Saúde Pública

Food processing and cardiometabolic risk factors: a systematic review

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ABSTRACT

OBJECTIVE: To systematically review the evidence for the association between food



British Journal of Nutrition, page 1 of 11
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Consumption of ultra-processed foods and health status: a systematic review and meta-analysis

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(Submitted 27 March 2020 – Final revision received 30 June 2020 – Accepted 9 July 2020)

Abstract

Increasing evidence suggests that high consumption of ultra-processed foods (UPF) is associated with an increase in non-communicable diseases, overweight and obesity. The present study systematically reviewed all observational studies that investigated the association between UPF



Review

Ultra-Processed Food Consumption and Adult Mortality Risk: A Systematic Review and Dose–Response Meta-Analysis of 207,291 Participants

Wanich Suksatan¹, Sajjad Moradi^{2,3,*}, Fatemeh Naeini⁴, Reza Bagheri⁵, Hamed Mohammadi⁴, Sepide Talebi⁴, Sanaz Mehrabani⁶, Mohammad ali Hoojati Kermani⁷ and Katsuhiko Suzuki^{8,*}

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Three meta-analyses of high-quality cohort studies show significant pooled risk ratios for overweight and obesity, type 2 diabetes, depression, cardiovascular and cerebrovascular disease and death, and all-cause mortality



British Journal of Nutrition, page 1 of 11. doi:10.1017/S0007114520002688
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³Department of Epidemiology and Prevention, IRCCS Neuromed, Pozzilli, 86077 Isernia, Italy
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Review

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International Journal of Epidemiology, 2021, 1–22
https://doi.org/10.1093/ije/dyab247
Original Article

Original Article

Ultra-processed food and risk of type 2 diabetes: a systematic review and meta-analysis of longitudinal studies

Felipe Mendes Delpino^{1,2*}, Lilian Munhoz Figueiredo³, Renata Moraes Bielemann⁴, Bruna Gonçalves Cordeiro da Silva⁵, Francine Silva dos Santos^{6,7}, Giclele Costa Mintem⁴, Thayná Ramos Flores⁵, Ricardo Alexandre Arcêncio², Bruno Pereira Nunes^{1,3}

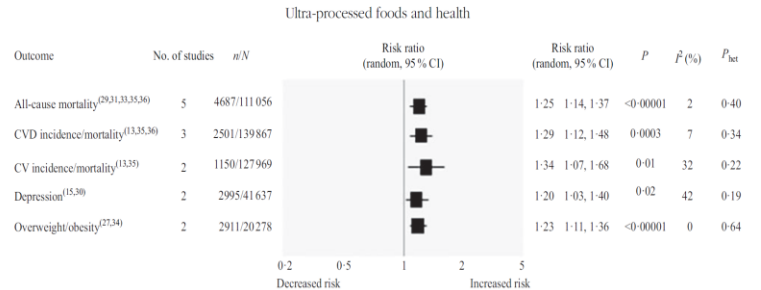
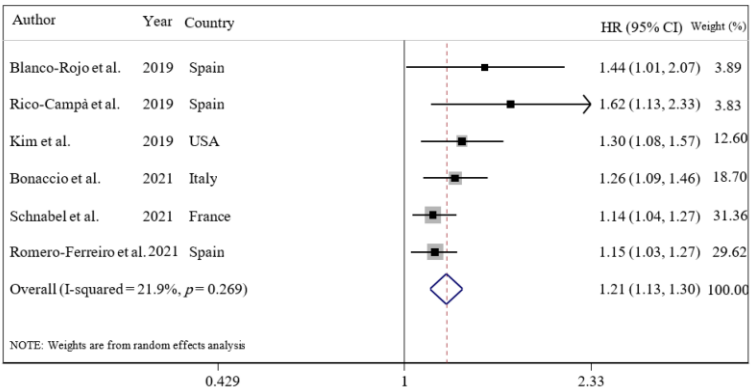


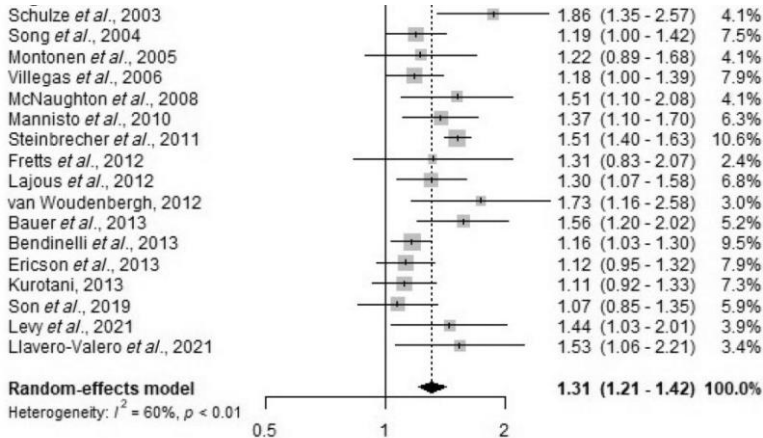
Fig. 3. Forest plot of prospective cohort studies investigating the association between ultra-processed foods consumption and different health outcomes. P value is for test of no overall association between exposure and outcome; P_{het} is for test of no differences in association measure among studies; I² estimates from heterogeneity; CV, cerebrovascular.

Nutrients 2022, 14, 174

8.



NOTE: Weights are from random effects analysis



Heterogeneity: I² = 60%, p < 0.01

11 cohort studies show association between UPF and obesity/adiposity/weight gain

Spanish adults



Ultraprocessed food consumption and risk of overweight and obesity: the University of Navarra Follow-Up (SUN) cohort study^{1,2}

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ABSTRACT
Background: Ultraprocessed food consumption has increased in the past decade. Evidence suggests a positive association between ultraprocessed food consumption and the incidence of overweight and obesity. However, few prospective studies to our knowledge have investigated this potential relation in adults.
Objective: We evaluated the association between ultraprocessed food consumption and the risk of overweight and obesity in a prospective Spanish cohort, the SUN (University of Navarra Follow-Up) study.
Design: We included 8451 middle-aged Spanish university graduates who were initially not overweight or obese and followed up for

were obese, and in the Eastern Mediterranean ~25% of women and 15% of men were obese (1).
Changes in the food system continuously promote obesity. There is now a greater availability of ready-to-eat or -heat foods known as ultraprocessed foods, which are products that have little, if any, whole foods and are manufactured with substances extracted from foods or synthesized in laboratories (dyes, flavorings, and other additives) (2). They have high amounts of fat, sugar, and salt and a high energy density and low fiber content; they are extremely palatable foods that are aggressively advertised

Downloaded from https://academic.oup.com/ajph/

PLOS MEDICINE

French adults

RESEARCH ARTICLE

Ultra-processed food intake in association with BMI change and risk of overweight and obesity: A prospective analysis of the French NutriNet-Santé cohort

Marie Beslay^{1†}, Bernard Srour^{1†*}, Caroline Méjean², Benjamin Allès¹, Thibault Fliolet³, Charlotte Debras⁴, Eloi Chazelas¹, Mélanie Deschases¹, Méyomo Gaelle Wendeu-Foyet⁵, Serge Hercberg^{1,3}, Pilar Galan¹, Carlos A. Monteiro⁶, Valérie Deschamps⁷, Giovanna Calixto Andrade^{1,4}, Emmanuelle Kesse-Guyot⁸, Chantal Julia^{1,3}, Mathilde Touvier⁹

¹ Sorbonne Paris Nord University, Inserm, INRAE, Cnam, Nutritional Epidemiology Research Team (EREN), Epidemiology and Statistics Research Center—University of Paris (CRESS), Bobigny, France, ² MOISA, Univ Montpellier, CIRAD, CIHEAM-IAMM, INRAE, Montpellier SupAgro, Montpellier, France, ³ Public Health Department, Avicenne Hospital, AP-HP, Bobigny, France, ⁴ Department of Nutrition, School of Public Health, University of São Paulo, São Paulo, Brazil, ⁵ Santé Publique France (The French Public Health Agency), Nutritional Epidemiology Surveillance Team (ESEN), ⁶ Department of Preventive Medicine, Medical School, University of São Paulo, São Paulo, Brazil



Brazilian adults

Public Health Nutrition: 23(6), 1076–1086 doi:10.1017/S1368980019002854

Ultra-processed foods, incident overweight and obesity, and longitudinal changes in weight and waist circumference: the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil)

Scheine Leite Canhada^{1,2}, Vivian Cristine Lufi^{1,3,4,*}, Luana Giatti⁵, Bruce Bartholow Duncan^{1,2}, Dora Chor⁶, Maria de Jesus M da Fonseca⁶, Sheila Maria Alvim Matos⁷, Maria del Carmen Bisi Molina⁸, Sandhi Maria Barreto⁵, Renata Bertozzi Levy⁹ and Maria Inês Schmidt^{1,2}

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Submitted 20 December 2018; Final revision received 13 May 2019; Accepted 24 June 2019; First published online 17 October 2019

Chinese adults



Article

Ultra-Processed Food Consumption Associated with Overweight/Obesity among Chinese Adults—Results from China Health and Nutrition Survey 1997–2011

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Abstract: The association between the consumption of ultra-processed food (UPF) with overweight/obesity in Chinese adults has not been investigated. This study included a cohort of 12,451 adults aged >20 years who participated at least twice in the China Nutrition and Health Survey (CNHS) during 1997–2011. Food intake at each survey was assessed using a 3-day 24-h dietary recall. Body weight (kg), height (m), and waist circumference (WC) were measured during the survey. UPF was defined by the NOVA classification. Mixed effect logistic regression analyses were used. The mean UPF consumption of the study population (baseline mean age 43.7 years)

UK adults

European Journal of Nutrition
https://doi.org/10.1007/s00394-020-02367-1

ORIGINAL CONTRIBUTION



Ultra-processed food consumption and risk of obesity: a prospective cohort study of UK Biobank

Fernanda Rauber^{1,2,3}, Kiara Chang¹, Eszter P. Vámos³, Maria Laura da Costa Louzada^{1,2}, Christopher Milllett^{1,3}, Renata Bertazzi Levy^{1,4}

Received: 28 February 2020 / Accepted: 3 August 2020
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Abstract
Objective The objective of this study was to examine the associations between ultra-processed food consumption and risk of obesity among UK adults.
Methods Participants aged 40–69 years at recruitment in the UK Biobank (2006–2019) with dietary intakes collected using 24-h recall and repeated measures of adiposity—body mass index (BMI), waist circumference (WC) and percentage of body fat (% BF)—were included ($N = 22,659$; median follow-up: 5 years). Ultra-processed foods were identified using the NOVA classification and their consumption was expressed as a percentage of total energy intake. Multivariable Cox proportional

European adults

Clinical Nutrition 40 (2021) 5079–5088



Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: <http://www.elsevier.com/locate/clnu>



Original article

Consumption of ultra-processed foods associated with weight gain and obesity in adults: A multi-national cohort study

Reynalda Cordova^{a,b}, Nathalie Kliemann^a, Inge Huybrechts^a, Fernanda Rauber^{c,d}, Eszter P. Vámos^e, Renata Bertazzi Levy^{c,d}, Karl-Heinz Wagner^b, Vivian Viallon^a, Corinne Casagrande^a, Geneviève Nicolas^a, Christina C. Dahm^f, Jie Zhang^f, Jytte Halkjær^g, Anne Tjønneland^{g,h}, Marie-Christine Boutron-Ruault^{i,j}, Francesca Romana Mancini^{i,j}, Nasser Laouali^{i,j}, Verena Katzke^k, Bernard Srour^k, Franziska Jannasch^{l,m,n}, Matthias B. Schulze^{l,o}, Giovanna Masala^p, Sara Grioni^q, Salvatore Panico^r, Yvonne T. van der Schouw^s, Jeroen W.G. Derksen^s, Charlotta Rylander^t, Guri Skeie^t, Paula Jakšyn^{u,v}, Miguel Rodríguez-Barranco^{w,x,y}, José María Huerta^{z,aa}, Aurelio Barricarte^{y,ab,ac}, Lousie Brunkwall^{ad}, Stina Ramne^{ad}, Stina Bodén^{ae}



Brazilian children

UK children and young adults

US pregnant women and neonates



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doi: 10.1093/ije/dyaa141
Advance Access Publication Date: 5 September 2020
Original article



Effects of Diet

Role of ultra-processed food in fat mass index between 6 and 11 years of age: a cohort study

Caroline dos Santos Costa,^{1,2*} Maria Cecília Formoso Assunção,³ Christian Loret de Mola,⁴ Juliane de Souza Cardoso,⁵ Alicia Matijasevich⁶,⁶ Aluísio JD Barros⁶ and Iná S Santos³

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Research

JAMA Pediatrics | Original Investigation

Association Between Childhood Consumption of Ultraprocessed Food and Adiposity Trajectories in the Avon Longitudinal Study of Parents and Children Birth Cohort

Kiara Chang, PhD; Neha Khandpur, PhD; Daniela Neri, PhD; Mathilde Touvier, PhD; Inge Huybrechts, PhD; Christopher Millett, PhD; Eszter P. Vamos, PhD

IMPORTANCE Reports of associations between higher consumption of ultraprocessed foods (UPF) and elevated risks of obesity, noncommunicable diseases, and mortality in adults are increasing. However, associations of UPF consumption with long-term adiposity trajectories have never been investigated in children.

OBJECTIVE To assess longitudinal associations between UPF consumption and adiposity trajectories from childhood to early adulthood.

DESIGN, SETTING, AND PARTICIPANTS This prospective birth cohort study included children who participated in the Avon Longitudinal Study of Parents and Children (ALSPAC) in Avon County, southwest England. Children were followed up from 7 to 24 years of age during the study period from September 1, 1998, to October 31, 2017. Data were analyzed from March 1, 2020, to January 31, 2021.

Supplemental content

Spanish older adults



Article

Ultra-Processed Food Consumption Is Associated with Abdominal Obesity: A Prospective Cohort Study in Older Adults

Helena Sandoval-Insausti^{1,2}, Manuel Jiménez-Onsurbe¹, Carolina Donat-Vargas^{1,3,4}, Jimena Rey-García^{1,5}, José R. Banegas¹, Fernando Rodríguez-Artalejo^{1,3} and Pilar Guallar-Castillón^{1,3,*}

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Relationships between consumption of ultra-processed foods, gestational weight gain and neonatal outcomes in a sample of US pregnant women

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ABSTRACT

Background. An increasingly large share of diet comes from ultra-processed foods (UPFs), which are assemblages of food substances designed to create durable, convenient and palatable ready-to-eat products. There is increasing evidence that high UPF consumption is indicative of poor diet and is associated with obesity and metabolic disorders. This study sought to examine the relationship between percent of energy intake from ultra-processed foods (PULF) during pregnancy and maternal

Spanish adults



Original article

Contribution of ultra-processed foods in visceral fat deposition and other adiposity indicators: Prospective analysis nested in the PREDIMED-Plus trial

Jadwiga Konieczna^{a,b,*}, Marga Morey^{a,b}, Itziar Abete^{b,c}, Maira Bes-Rastrollo^{b,d}, Miguel Ruiz-Canela^{b,d}, Jesus Vioque^{e,f}, Sandra Gonzalez-Palacios^{e,f}, Lidia Daimiel^g, Jordi Salas-Salvado^{b,h,i}, Miguel Fiol^{a,b}, Vicente Martín^{e,j}, Ramón Estruch^{b,k}, Josep Vidal^{l,m}, Miguel A. Martínez-González^{b,d,n}, Silvia Canudas^{b,h,i}, Antoni J. Jover^o, Tania Fernández-Villa^j, Rosa Casas^{b,k}, Romina Olbeya^m, Pilar Buil-Cosiales^{b,d,p}, Nancy Babio^{b,h,i}, Helmut Schröder^{e,q}, J. Alfredo Martínez^{b,c,r}, Dora Romaguera^{a,b}, on behalf PREDIMED-Plus investigators¹

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Four cohort studies show association between UPF and type 2 diabetes

French adults

Research

JAMA Internal Medicine | Original Investigation

Ultraprocessed Food Consumption and Risk of Type 2 Diabetes Among Participants of the NutriNet-Santé Prospective Cohort

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IMPORTANCE Ultraprocessed foods (UPF) are widespread in Western diets. Their consumption has been associated in recent prospective studies with increased risks of all-cause mortality and chronic diseases such as cancer, cardiovascular diseases, hypertension, and dyslipidemia; however, data regarding diabetes are lacking.

OBJECTIVE To assess the associations between consumption of UPF and risk of type 2 diabetes (T2D).

 Supplier

Spanish adults

Clinical Nutrition 40 (2021) 2817–2824



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journal homepage: <http://www.elsevier.com/locate/clnu>



Original article

Ultra-processed foods and type-2 diabetes risk in the SUN project: A prospective cohort study

María Llaverro-Valero ^{a, b}, Javier Escalada-San Martín ^{b, c, d}, Miguel A. Martínez-González ^{a, c, d, e}, Francisco Javier Basterra-Gortari ^{a, d, f}, Carmen de la Fuente-Arrillaga ^{a, c, d}, Maira Bes-Rastrollo ^{a, c, d, *}

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Brazilian adults

ARTICLE IN PRESS

Clinical Nutrition xxx (xxxx) xxx



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Clinical Nutrition

journal homepage: <http://www.elsevier.com/locate/clnu>

Original article

Ultra-processed food consumption and type 2 diabetes incidence: A prospective cohort study

Renata B. Levy ^{a, b, d, *}, Fernanda Rauber ^{a, b, c}, Kiara Chang ^d, Maria Laura da C. Louzada ^{b, c}, Carlos A. Monteiro ^{b, c}, Christopher Millett ^{a, b, d}, Eszter P. Vamos ^d

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Dutch adults

Duan et al. BMC Medicine (2022) 20:7
<https://doi.org/10.1186/s12916-021-02200-4>

BMC Medicine

RESEARCH ARTICLE

Open Access

Ultra-processed food and incident type 2 diabetes: studying the underlying consumption patterns to unravel the health effects of this heterogeneous food category in the prospective Lifelines cohort

Ming-Jie Duan ^{1†}, Petra C. Vinke ^{2†}, Gerjan Navis ¹, Eva Corpeleijn ² and Louise H. Dekker ^{1,3}

Abstract

Background: The overall consumption of ultra-processed food (UPF) has previously been associated with type 2 diabetes. However, due to the substantial heterogeneity of this food category, in terms of their nutritional



Cell

Metabolism

Volume 30
Number 1

July 2, 2019

www.cell.com

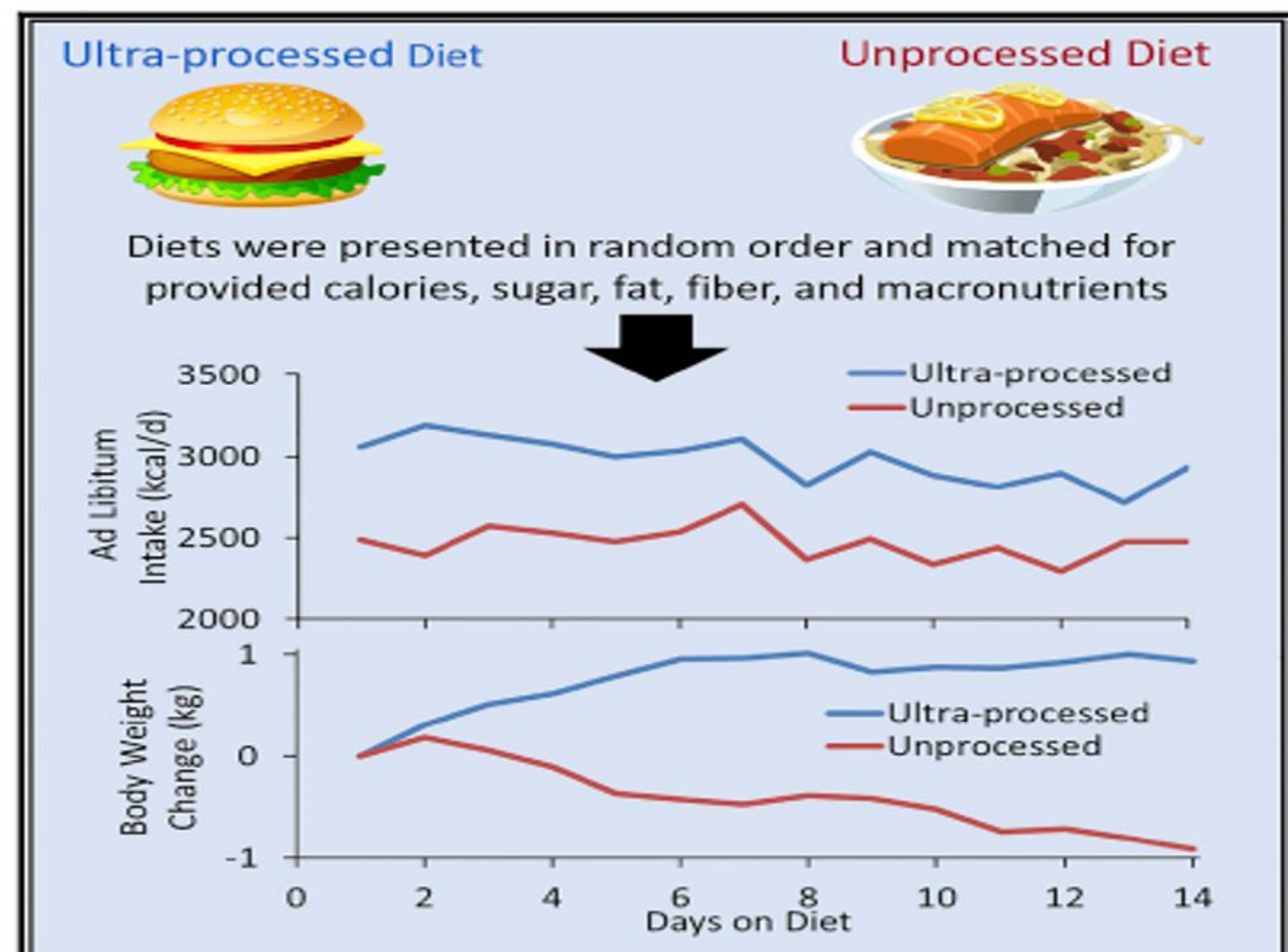


Ultra-Processed Foods and Obesity

Cell Metabolism

Ultra-Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of *Ad Libitum* Food Intake

Graphical Abstract



Authors

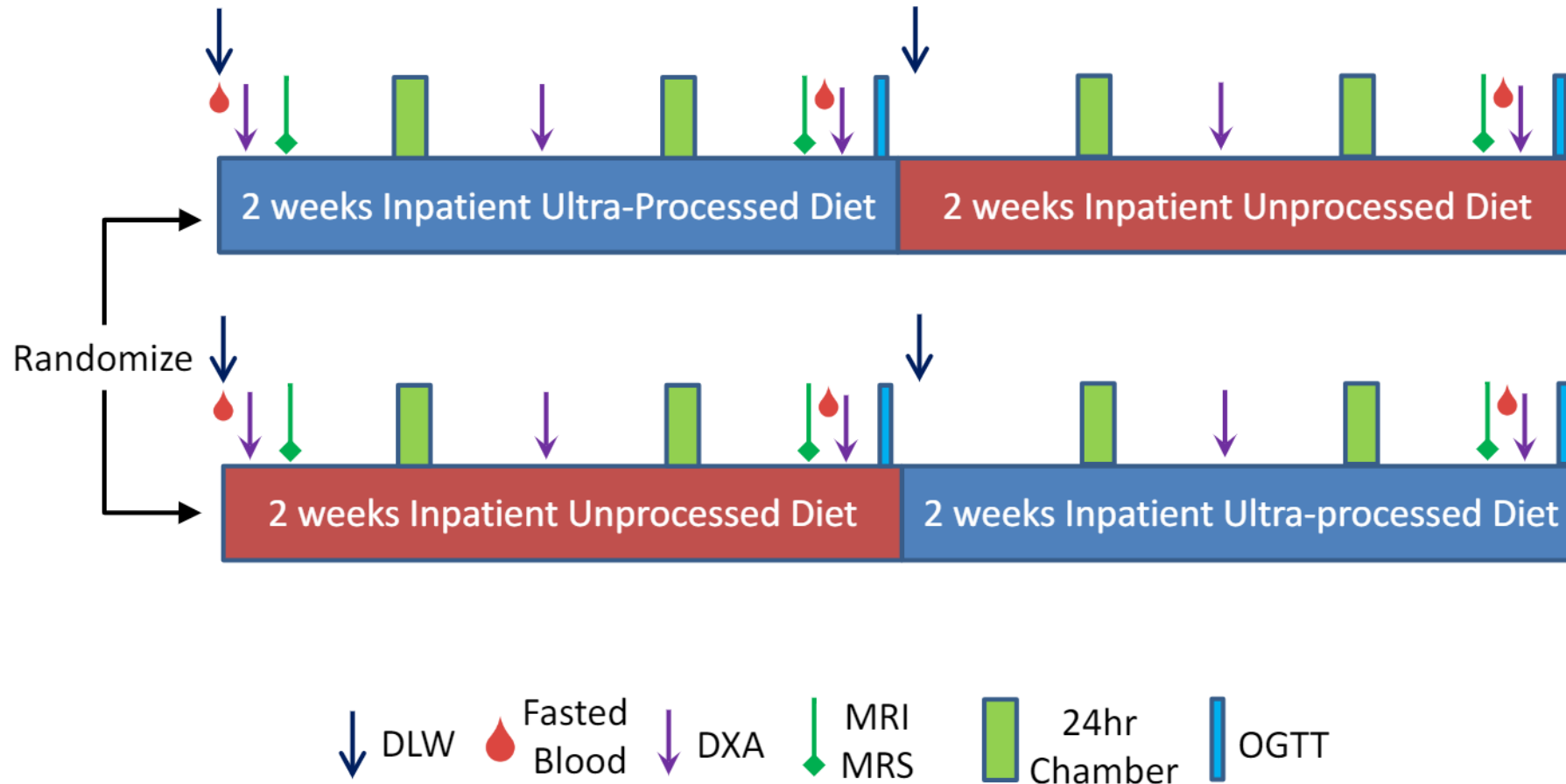
Kevin D. Hall, Alexis Ayuketah, Robert Brychta, ..., Peter J. Walter, Shanna Yang, Megan Zhou

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In Brief

Hall et al. investigated 20 inpatient adults who were exposed to ultra-processed versus unprocessed diets for 14 days each, in random order. The ultra-processed diet caused increased *ad libitum* energy intake and weight gain despite being matched to the unprocessed diet for presented calories, sugar, fat, sodium, fiber, and macronutrients.



Overview of the study design. Twenty adults were confined to metabolic wards where they were randomized to consumed either an ultra-processed or unprocessed diet for 2 consecutive weeks followed immediately by the alternate diet.



Ultra-processed Menu

Day 2

Breakfast

Croissant (Chef Pierre)

Margarine (Glenview Farms)

Turkey sausage (Ember Farms)

Blueberry yogurt (Yoplait) with NutriSource fiber



Non ultra-processed Menu

Day 2

Breakfast

Scrambled egg (made from fresh eggs)

Hash brown potatoes (potato, garlic, paprika (Simply Organic), ground turmeric (McCormick), cream (Stoneyfield) and onions)

Salt and Pepper (Monarch)



Ultra-processed Menu

Day 4

Lunch

Hot dog (Patuxent Farms) on bun (Hilltop Hearth) with ketchup (Heinz) and yellow mustard (Monarch)
 Baked potato chips (Lay's)
 Cranberry juice (Sun Cup) with NutriSource fiber
 Blueberry yogurt (Yoplait) with NutriSource fiber



Non ultra-processed Menu

Day 4

Lunch

Baked cod filet (Harbor Banks) with fresh squeezed lemon juice
 Baked russet potato with olive oil
 Steamed broccoli with olive oil and garlic
 Side salad (green leaf lettuce, tomatoes, cucumber and carrots)
 Vinaigrette (balsamic vinegar (Nature's Promise) and olive oil)
 Salt and Pepper (Monarch)



Ultra-processed Menu

Day 7

Dinner

Peanut butter (Monarch) and jelly (Monarch) sandwich on white bread (Ottenberg)
 2% milk (Cloverland) with NutriSource fiber
 Baked Cheetos (Frito-Lay)
 Graham crackers (Nabisco)
 Chocolate pudding (Snack Pack) with NutriSource fiber



Non ultra-processed Menu

Day 7

Dinner

Penne pasta (Barilla) primavera (olive oil, garlic, pinto beans (cooked from dried), spinach, basil, tomatoes)
 Side salad (green leaf lettuce, baby carrots, broccoli)
 Vinaigrette (red wine vinegar (Giant) and olive oil)
 Salt and Pepper (Monarch)
 Grapes



Ultra-processed Menu

Daily Snacks

Baked Potato Chips (Lay's), Dry Roasted Peanuts (Planters), Cheese & Peanut Butter Sandwich Crackers (Keebler), Goldfish Crackers (Pepperidge Farm), Applesauce (Lucky Leaf).

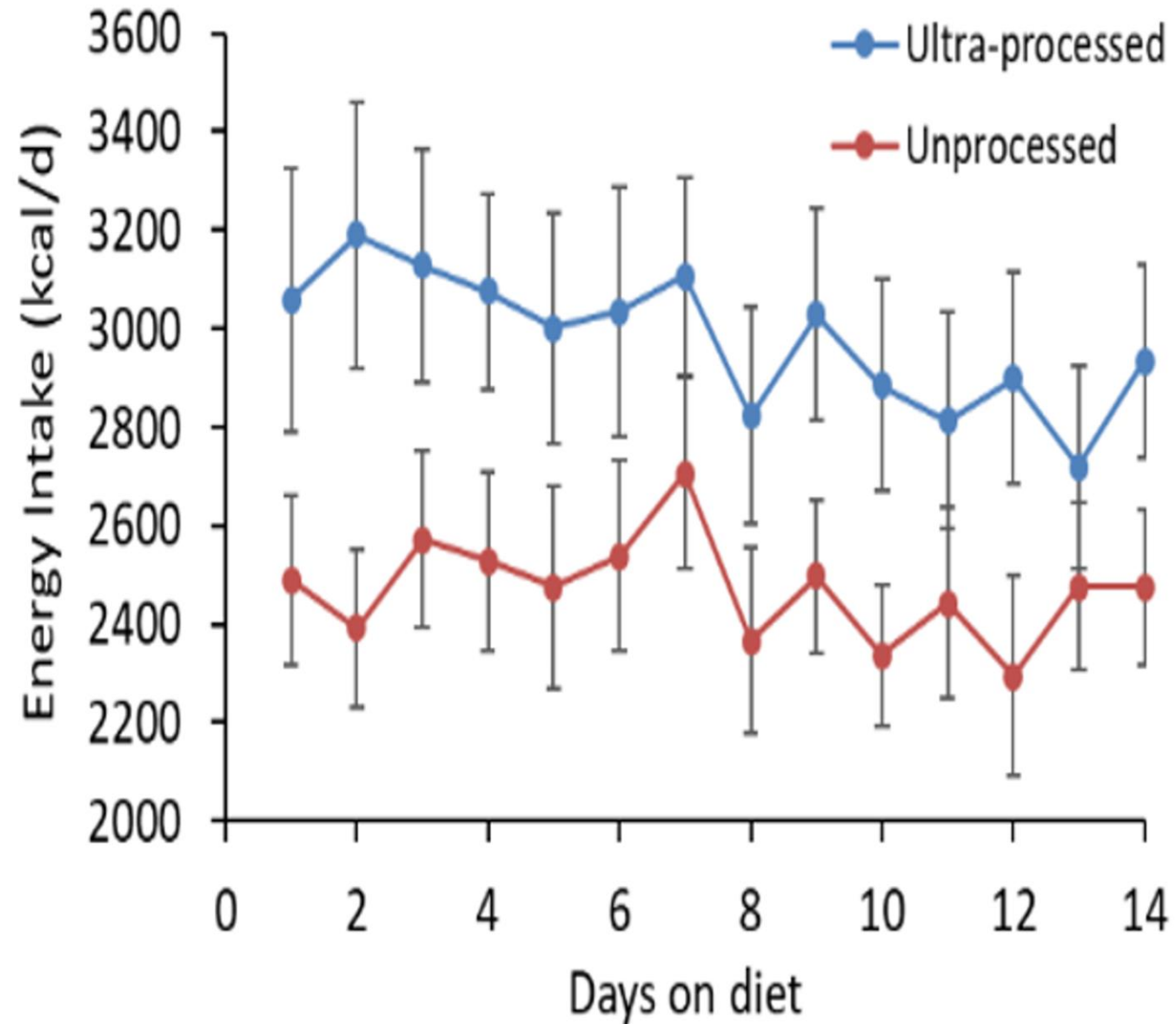


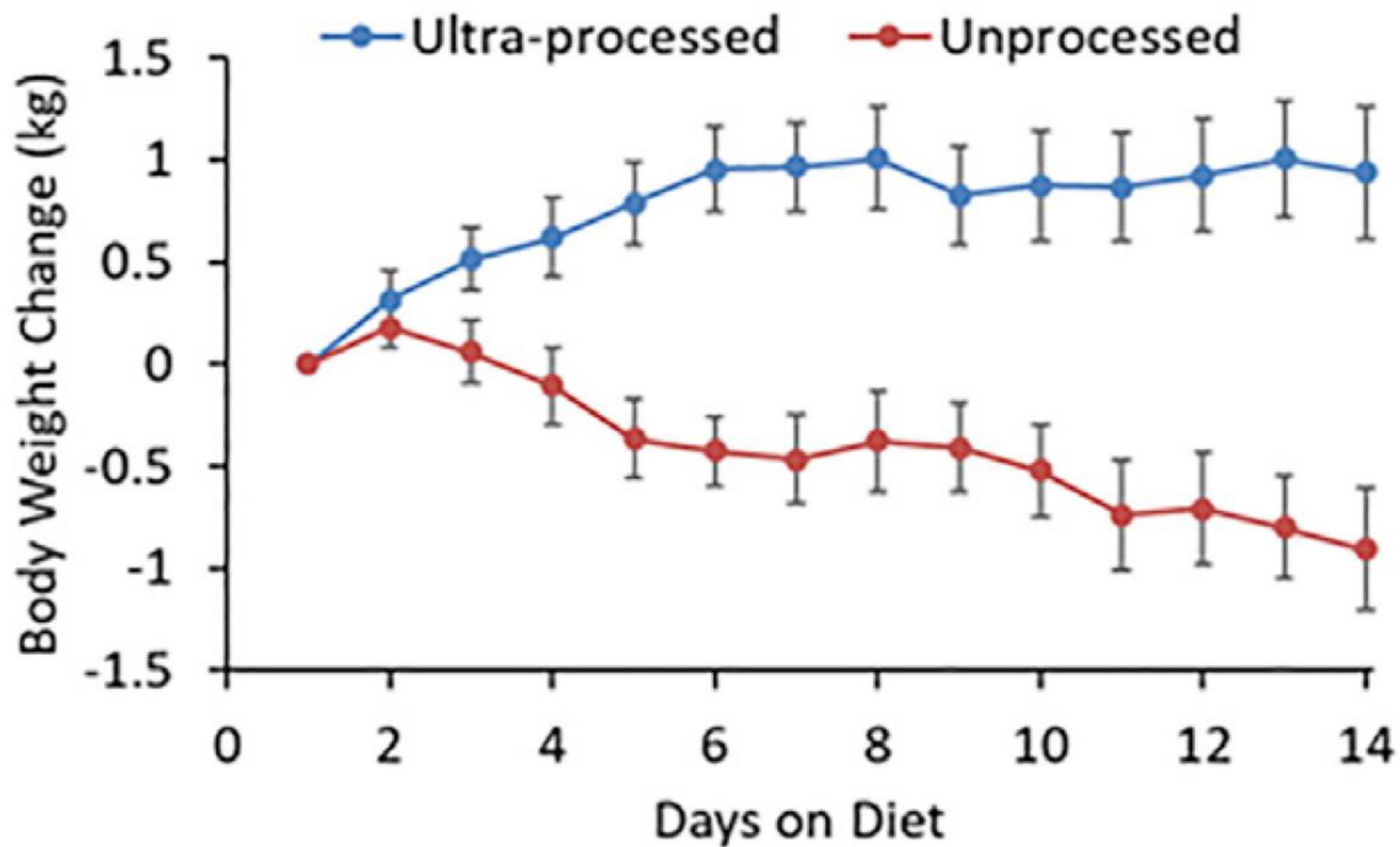
Non ultra-processed Menu

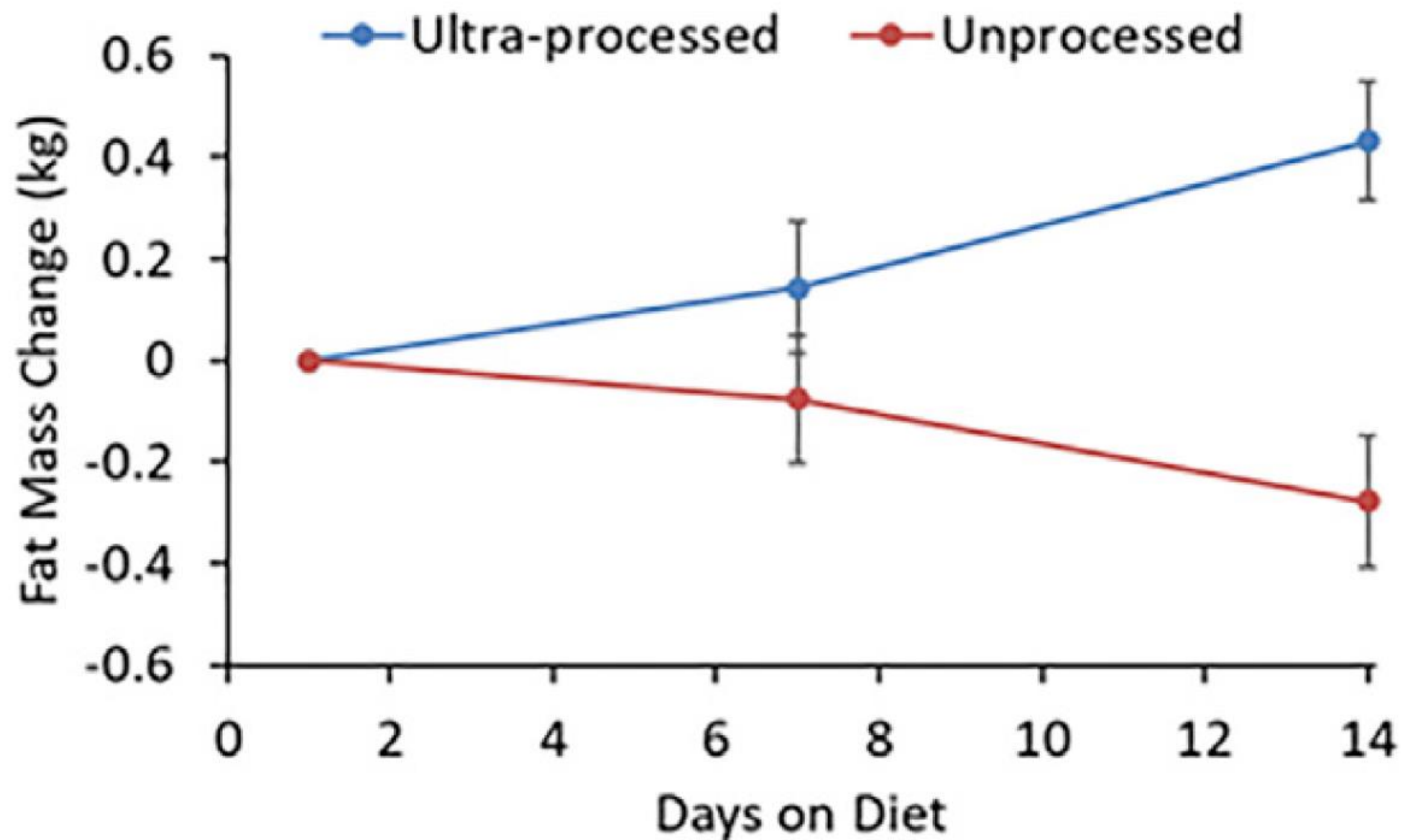
Daily Snacks

Fresh oranges and apples, raisins (Monarch), raw almonds (Giant), chopped walnuts (Diamond)

Energy intake was consistently higher during the ultra-processed diet



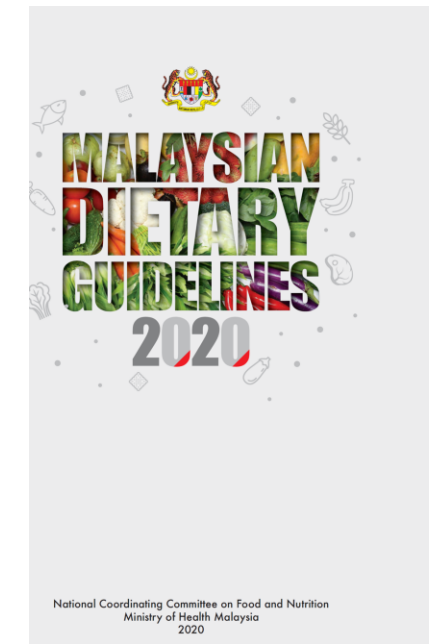
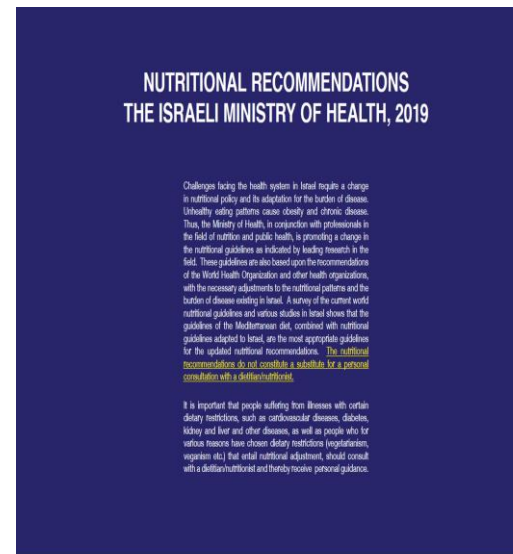
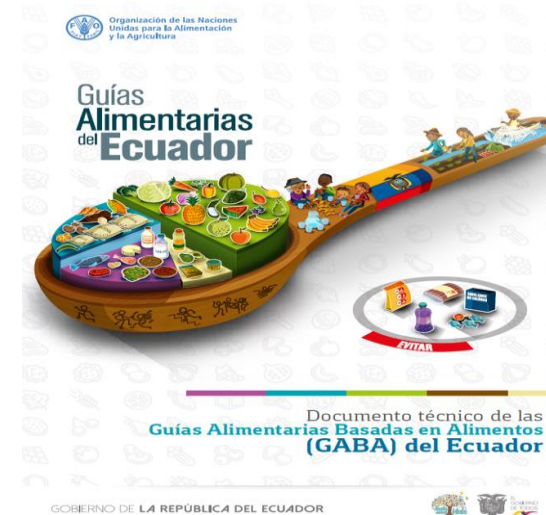
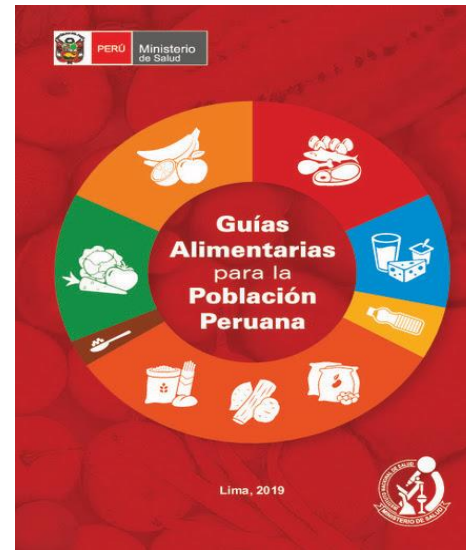
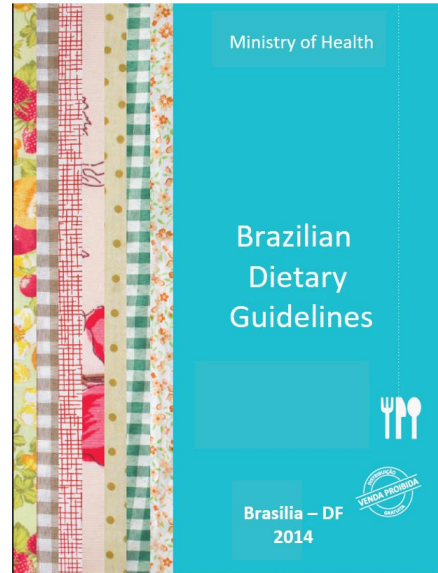


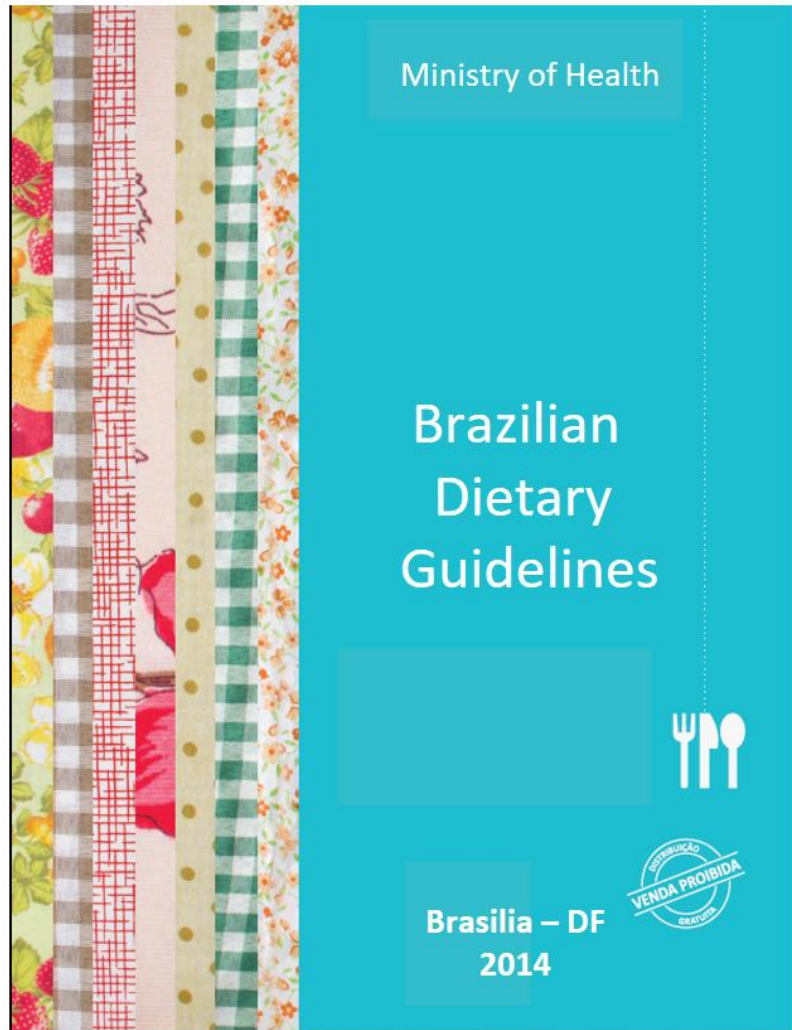


The NOVA food classification system

- Rationale
- Description
- Uses and applications:
 - Description of food processing-based dietary patterns
 - Effect of food processing-based dietary patterns on diet quality and disease
 - Development of dietary recommendations
 - Policy and program goals and regulations
- Developments/improvements

Brazil (2014), Uruguay (2016), Ecuador (2018), Peru (2019), Israel (2019) and Malaysia (2020) national dietary guidelines use NOVA as a framework for dietary recommendations





Chapter 1 Principles

Chapter 2 Choosing foods (*considering food processing*)

Chapter 3 From foods to meals

Chapter 4 Mindful eating and commensality

Chapter 5 Understanding and overcoming obstacles

http://bvsms.saude.gov.br/bvs/publicacoes/dietary_guidelines_brazilian_population.pdf

Chapter 2. Choosing foods

Fresh or minimally processed foods



Make them the basis of your diet

In **great variety**, mainly of **plant origin**, and, **whenever possible, produced by agro-ecologic family farmers**, they are the basis for diets that are nutritious, delicious, culturally appropriate, and supportive of socially and environmentally sustainable food systems

Chapter 2. Choosing foods

Processed culinary ingredients



Oils



Salt



Sugar

Use in small amounts

when seasoning and cooking
unprocessed/minimally processed foods and
converting them into dishes and meals

As long as they are used in moderation, oils, fats, salt, and sugar contribute to diverse and delicious diets without making them nutritionally unbalanced

Chapter 2. Choosing foods

Processed foods



Bread



Cheese



Palm hearts

Eat in small amounts

as ingredients of dishes or part of meals based on unprocessed/minimally processed foods

The ingredients and techniques used in the manufacture of processed foods alter unfavorably the nutritional composition of the foods from which they are derived

Chapter 2. Choosing foods

Ultra-processed foods



Avoid

Because of their ingredients, ultra-processed products are **nutritionally unbalanced**. As a result of their formulation and presentation, they tend to be **consumed in excess**, and to **displace real foods**. Their means of production, distribution, marketing, and consumption **damage culture, social life, and the environment**.

The golden rule

Always prefer unprocessed or minimally processed foods and freshly made dishes and meals to ultra-processed products

Do not replace water, milk, fruit by soft drinks, dairy drinks, biscuits.

Opt for freshly prepared soups, pasta, pies, rice and beans, salads, steamed vegetables instead of packaged soups, instant noodles, packaged snacks, pre-prepared frozen dishes, sandwiches, sausages.

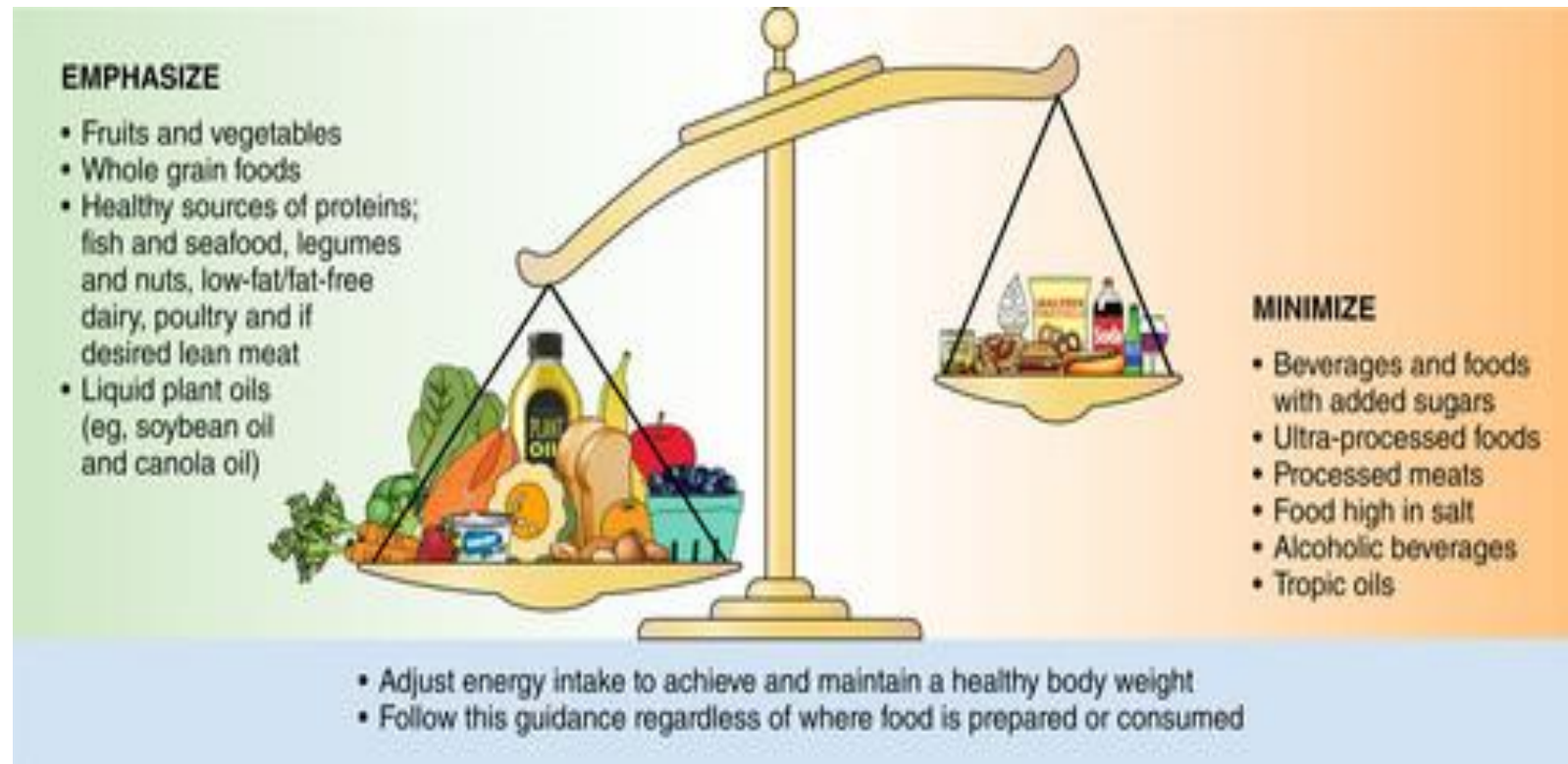
Stick to homemade desserts, avoiding industrialised ones.

AHA SCIENTIFIC STATEMENT

2021 Dietary Guidance to Improve Cardiovascular Health: A Scientific Statement From the American Heart Association

Alice H. Lichtenstein, DSc, FAHA, Chair*; Lawrence J. Appel, MD, MPH, FAHA, Vice Chair*; Maya Vadiveloo, PhD, RD, FAHA, Vice Chair; Frank B. Hu, MD, PhD, FAHA; Penny M. Kris-Etherton, PhD, RD, FAHA; Casey M. Rebholz, PhD, MS, MNRP, MPH, FAHA; Frank M. Sacks, MD, FAHA; Anne N. Thorndike, MD, MPH, FAHA; Linda Van Horn, PhD, RD, FAHA; Judith Wylie-Rosett, PhD, RD, FAHA; on behalf of the American Heart Association Council on Lifestyle and Cardiometabolic Health; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Cardiovascular Radiology and Intervention; Council on Clinical Cardiology; and Stroke Council

ABSTRACT: Poor diet quality is strongly associated with elevated risk of cardiovascular disease morbidity and mortality. This scientific statement emphasizes the importance of dietary patterns beyond individual foods or nutrients, underscores the critical role of nutrition early in life, presents elements of heart-healthy dietary patterns, and highlights structural challenges



“... we outline how Europe can move forward with implementation of effective policy action on taxation, food reformulation, and product labelling, advertising, and availability, similar to that implemented for tobacco, to reduce consumption of alcohol, **ultraprocessed foods**, and foods with added sugar, especially among young people.”

The Lancet Commissions

The EASL–Lancet Liver Commission: protecting the next generation of Europeans against liver disease complications and premature mortality



Tom H Karlsen, Nick Sheron†, Shira Zelber-Sagi, Patrizia Carrieri, Geoffrey Dusheiko, Elisabetta Bugianesi†, Rachel Pryke†, Sharon J Hutchinson, Bruno Sangro†, Natasha K Martin, Michele Cecchini, Mae Ashworth Dirac, Annalisa Belloni, Miquel Serra-Burriel, Cyriel Y Ponsioen, Brittney Sheena, Alienor Lerouge, Marion Devaux, Nick Scott, Margaret Hellard, Henkjan J Verkade, Ekkehard Sturm, Giulio Marchesini, Hannele Yki-Järvinen, Chris D Byrne, Giovanni Targher, Aviad Tur-Sinai, Damon Barrett, Michael Ninburg, Tatjana Reic, Alison Taylor, Tim Rhodes, Carla Treloar, Claus Petersen, Christoph Schramm, Robert Flisiak, Marieta Y Simonova, Albert Pares, Philip Johnson, Alessandro Cucchetti, Isabel Graupera, Christos Lionis, Elisa Pose, Núria Fabrellas, Ann T Ma, Juan M Mendive, Vincenzo Mazzaferro, Harry Rutter, Helena Cortez-Pinto, Deirdre Kelly†, Robyn Burton, Jeffrey V Lazarus†, Pere Ginès†, Maria Buti†, Philip N Newsome†‡, Patrizia Burra*‡, Michael P Manns*‡*

Executive summary

Liver diseases have become a major health threat across Europe, and the face of European hepatology is changing due to the cure of viral hepatitis C and the control of chronic viral hepatitis B, the increasingly widespread

care using multilevel interventions acting on current barriers.

Underlying this transformative shift is the need to enhance awareness of the preventable and treatable nature of many liver diseases. Therapeutic nihilism,

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Programa Nacional
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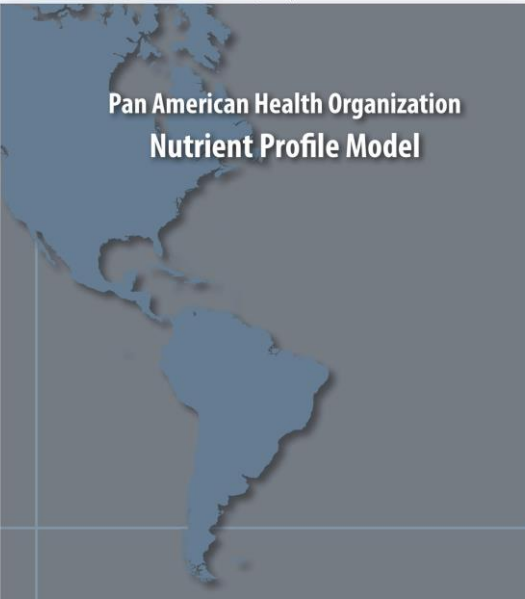
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**Pan American Health Organization
Nutrient Profile Model**



 Pan American
Health
Organization

 World Health
Organization
REGIONAL OFFICE FOR THE
AMERICAS

The NOVA food classification system

- Rationale
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- Developments/improvements:
 - NOVA in cell phone apps (Open Food Facts, Desrotulando)
 - Ultra-processed food intake score (being validated in several countries)
 - Data collection software that identifies NOVA food groups (being validated in Brazil)