

*Nutritional Determinants of Health:
Recent Research Discoveries and Translation into Public Health Action
Paris, College de France, June 27, 2023*

Food processing and human health:
the thesis and the evidence

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Food processing and human health

- The thesis and the underlying hypotheses
- The evidence and research gaps
- Policy implications

Food processing and human health: thesis and hypotheses

Public Health Nutrition 12(5), 729-31, 2009

doi:10.1017/S136898009005291

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 drinks. Thus, diets that are high in folate and in green leafy vegetables are recommended, whereas diets high in saturated fat and in full-fat milk and other dairy products are not recommended. Food guides such as the US Food Guide Pyramid are designed to encourage consumption of healthier foods, by which is usually meant those higher in vitamins, minerals and other nutrients seen as desirable.

What is generally overlooked in such approaches, which currently dominate official and other authoritative

Group 1 is of minimally processed foods. It is of whole foods that have been submitted to some process that does not substantially alter the nutritional properties of the original foods which remain recognisable as such, while aiming to preserve them and make them more accessible, convenient, sometimes safer, and more palatable. Such processes include cleaning, removal of inedible fractions, portioning, refrigeration, freezing, pasteurisation, fermenting, pre-cooking, drying, skimming, bottling and packaging. Fresh meat and milk, grains, pulses (legumes), nuts, and fruits, vegetables, roots and tubers sold as such, are usually minimally processed in various ways.



Public Health Nutrition 21(1), 5-17, 2018

doi:10.1017/S1368980017000234

Commentary

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

Carlos Augusto Monteiro^{1,2,*}, Geoffrey Cannon², Jean-Claude Moubarac^{2,3}, Renata Bertazzi Levy^{2,4}, Maria Laura C Louzada² and Patrícia Constante Jaime^{1,2}

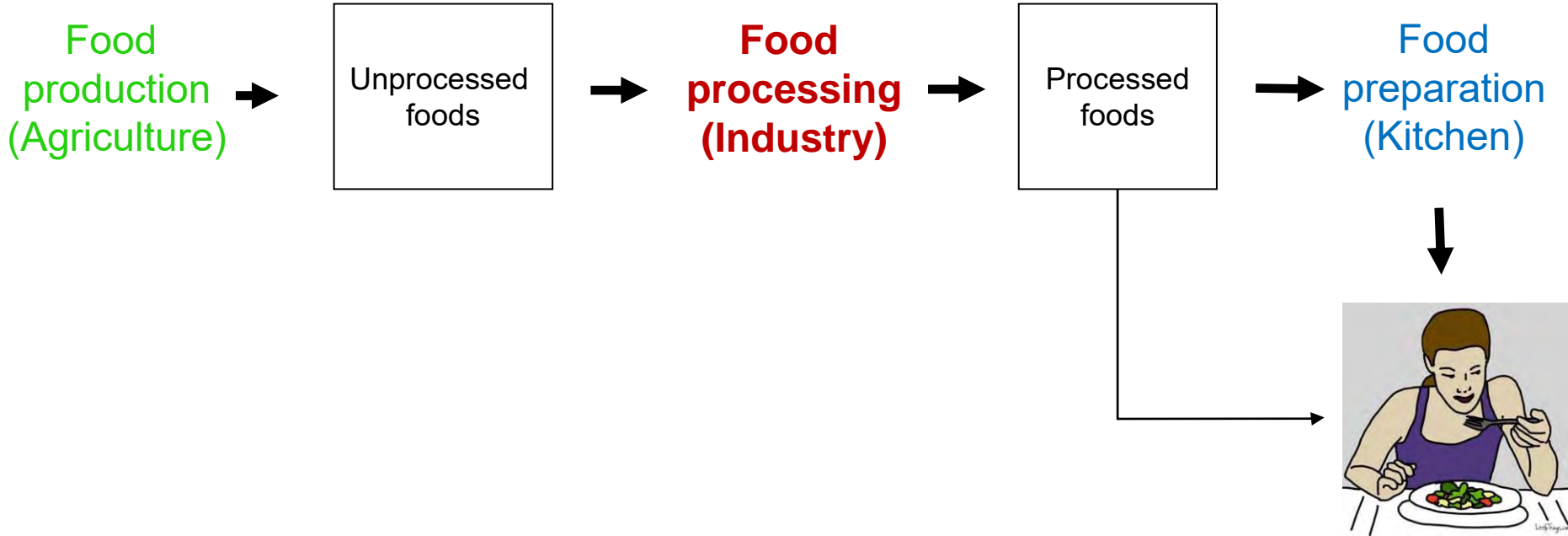
¹Department of Nutrition, School of Public Health, University of São Paulo, Av. Dr Arnaldo 715, São Paulo 01246-904, Brazil; ²Center for Epidemiological Research in Nutrition and Health, University of São Paulo, São Paulo, Brazil; ³Département de Nutrition, Université de Montréal, Montréal, Canada; ⁴Department of Preventive Medicine, School of Medicine, University of São Paulo, São Paulo, Brazil

Submitted 27 October 2016; Final revision received 18 January 2017; Accepted 23 January 2017; First published online 21 March 2017

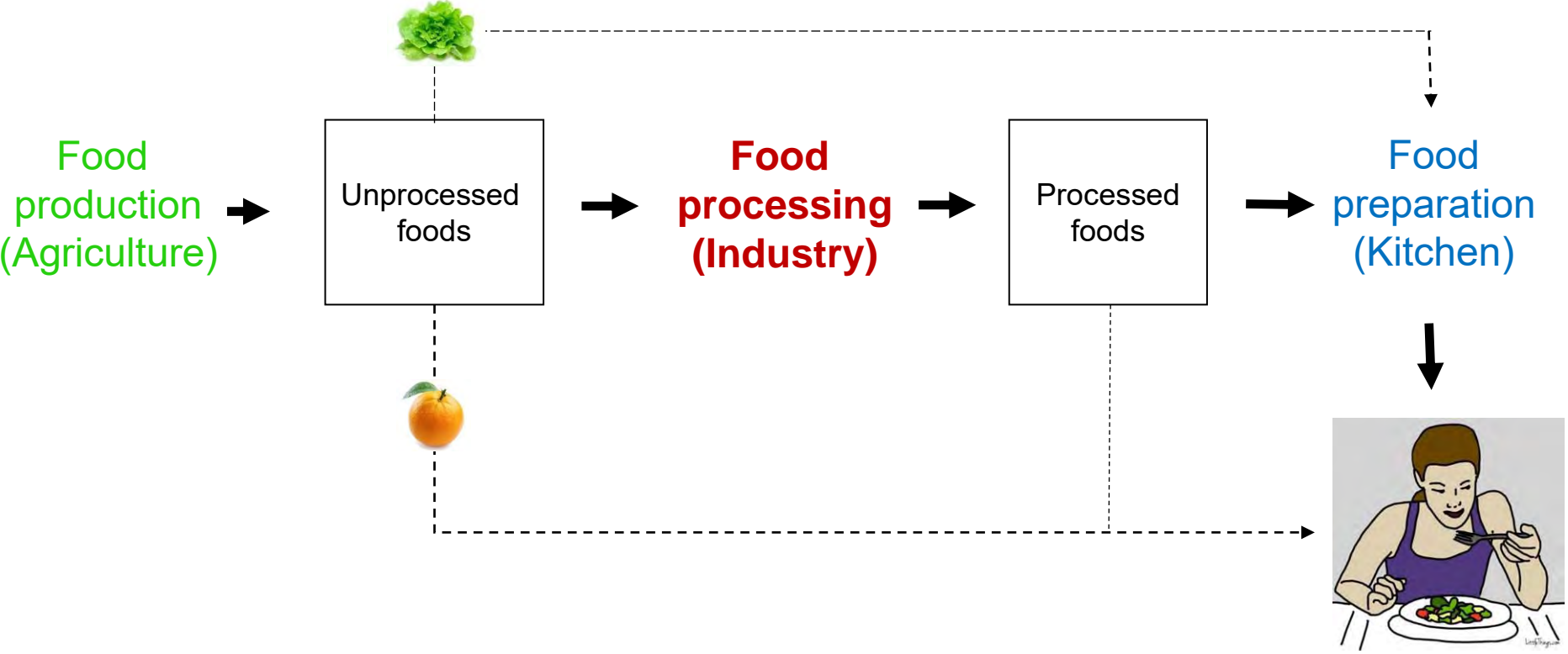
Abstract

Given evident multiple threats to food systems and supplies, food security, human health and welfare, the living and physical world and the biosphere, the years 2016–2025 are now designated by the UN as the Decade of Nutrition, in support of the UN Sustainable Development Goals. For these initiatives to succeed, it is

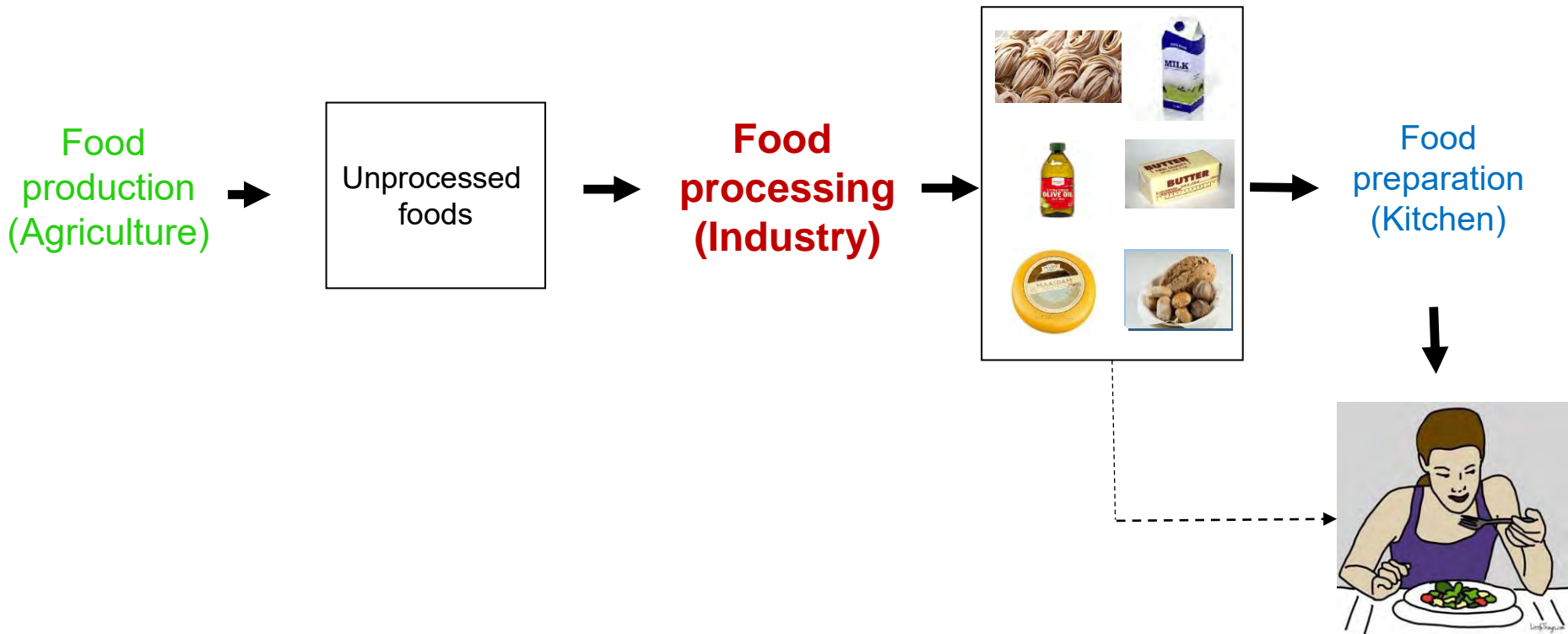
Food processing is an essential part of the food system !



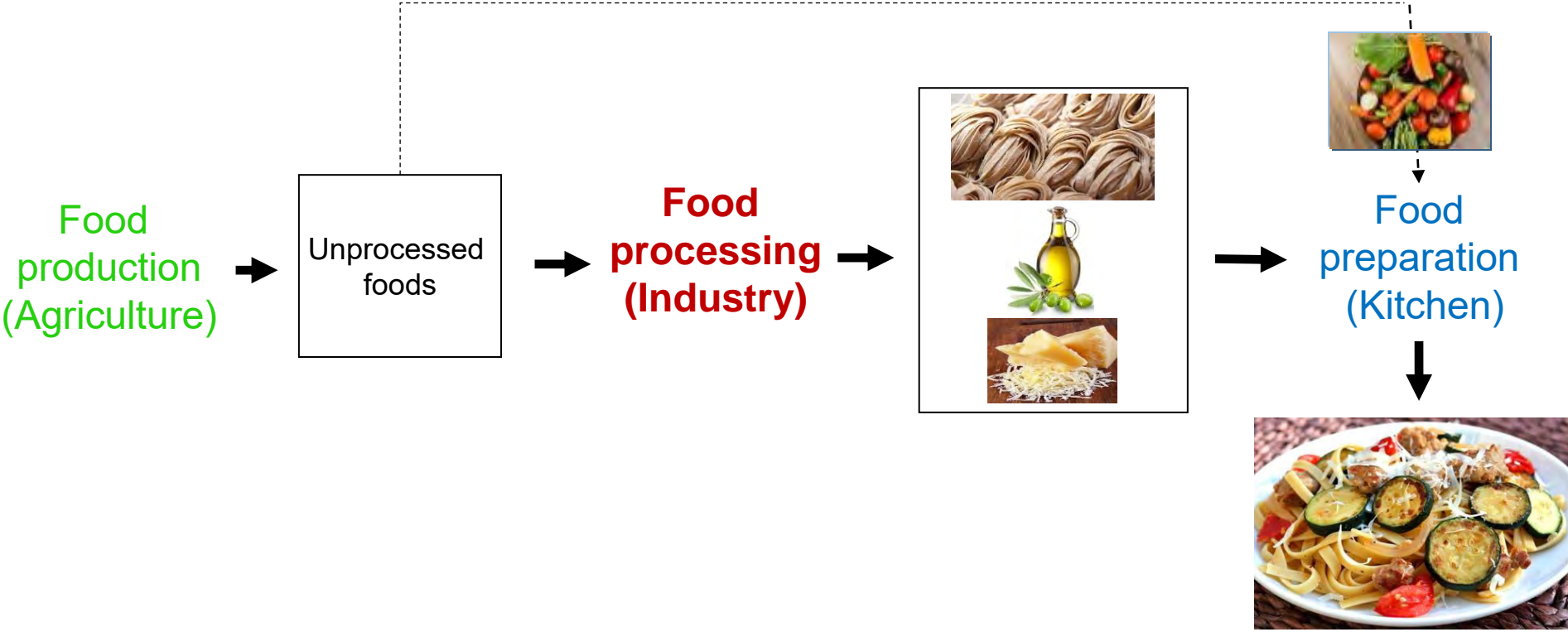
Only a few foods are not processed before arriving to our kitchens/mouths



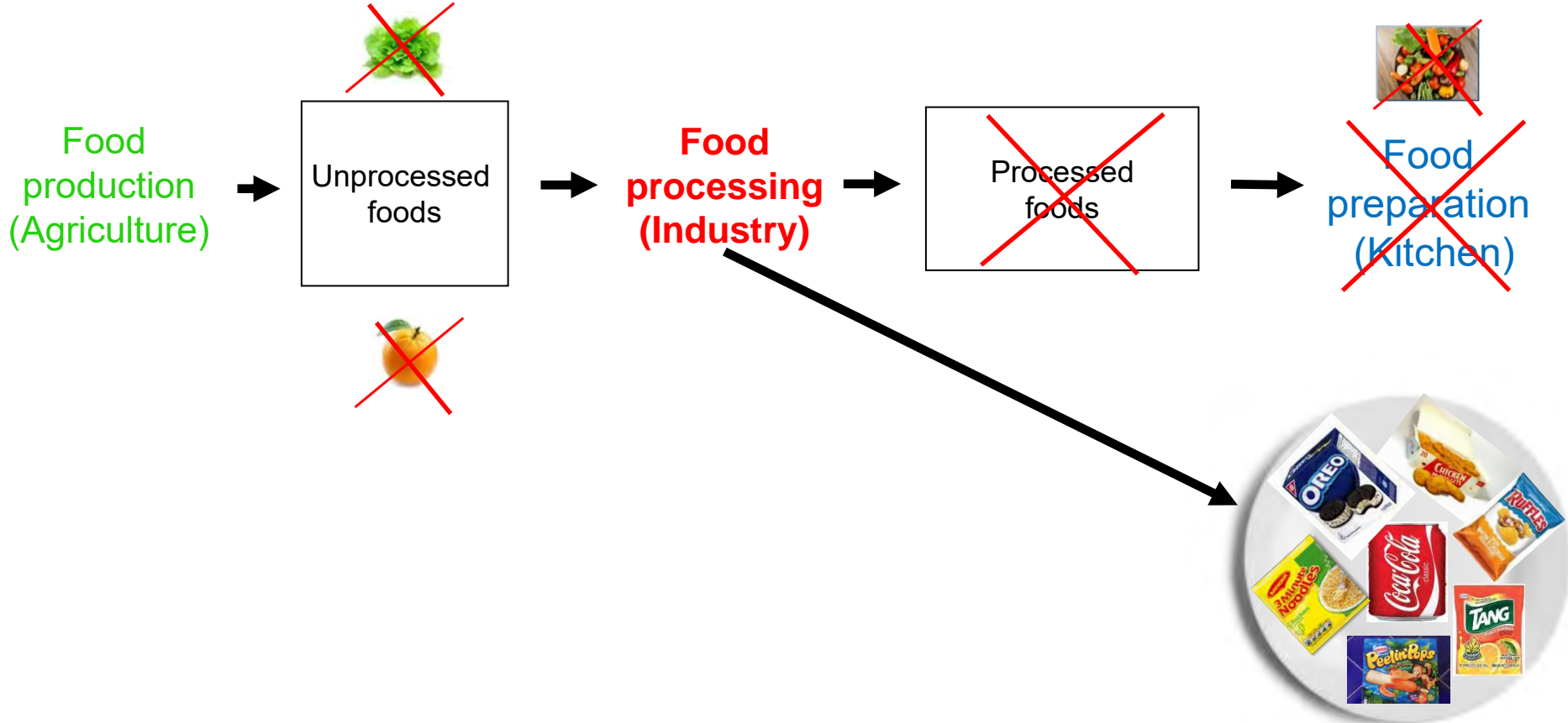
Advantages of food processing: it increases food duration, it facilitates and diversifies food culinary preparation, and it enhances food sensory properties



Traditional dietary patterns are made of a variety of unprocessed and processed foods combined into freshly prepared delicious dishes and meals



A more recent purpose of food processing is to create alternatives for foods and culinary preparations that maximize industry profits



To be competitive, the novel products must be more convenient (longer duration and ready-to-consume), tasteful, and affordable than foods and culinary preparations



To maximize profits, they must have a low cost of production

A new technology was necessary to create competitive and profitable substitutes for foods and culinary preparations

Food
production
(Agriculture)



Unprocessed
foods



Food (ultra-)
processing
(Industry)



Extraction of food substances from a few high-yield crops (soy, corn, wheat, sugar cane ...)

(starches/sugars/oils/fats/protein isolates)



Chemical modifications of food substances (hydrolysis, hydrogenation etc)



Assemblage of food substances (extrusion, deep frying etc)



Use of cosmetic additives (flavours, colours, emulsifiers etc)



Sophisticated packaging often using synthetic materials.

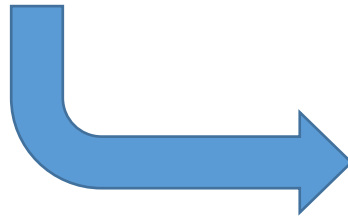
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What is generally overlooked in such approaches, which currently dominate official and other authoritative

Group 1 is of minimally processed foods. It is of whole foods that have been submitted to some process that does not substantially alter the nutritional properties of the original foods which remain recognisable as such, while aiming to preserve them and make them more accessible, convenient, sometimes safer, and more palatable. Such processes include cleaning, removal of inedible fractions, portioning, refrigeration, freezing, pasteurisation, fermenting, pre-cooking, drying, skimming, bottling and packaging. Fresh meat and milk, grains, pulses (legumes), nuts, and fruits, vegetables, roots and tubers sold as such, are usually minimally processed in various ways.















Food classification. Public health
NOVA. The star shines bright
























Carlos A. Monteiro, Geoffrey Cannon, Renata Levy, Jean-Claude Moubarac, Patricia Jaime, Ana Paula Martins, Daniela Canella, Maria Louzada, Diana Parra. Also with Camila Ricardo, Giovanna Calixto, Priscila Machado, Carla Martins, Euridice Martinez, Larissa Baraldi, Josefa Garzillo, Isabela Sattamini. Centre for Epidemiological Studies in Health and Nutrition, School of Public Health, University of São Paulo, Brazil

Nova: the food classification based on the **extent** and **purpose** of industrial processing

NOVA groups	Examples
<p>1) Unprocessed or minimally processed foods Edible parts of plants/animals after separation from nature or preserved by methods that largely keep the structure of the original food without adding salt, sugar, oils or fats</p>	   
<p>2) Processed culinary ingredients Substances extracted from Group 1 foods (or nature) and used to prepare, cook and season grains, vegetables, fruits, meat, milk, eggs etc</p>	   
<p>3) Processed foods Group 1 foods modified with the addition of salt, sugar, oils or fats to preserve them and or enhance their sensory qualities</p>	   
<p>4) Ultra-processed foods</p>	

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<p>3) Processed foods</p> <p>Group 1 foods modified with the addition of salt, sugar, oils or fats to preserve them and or enhance their sensory qualities</p>	   
<p>4) Ultra-processed foods</p> <p>Formulations of food-derived substances and additives designed to displace all other Nova groups and culinary preparations, and to maximize industry profits</p>	        

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}

¹Department of Nutrition, School of Public Health, University of São Paulo, São Paulo, Brazil; ²Center for Epidemiological Research in Nutrition and Health, Department of Nutrition, School of Public Health, University of São Paulo, Av. Dr Arnaldo 715, São Paulo, SP 01246-904, Brazil; ³Department of Preventive Medicine, School of Medicine, University of São Paulo, São Paulo, Brazil; ⁴Département de Nutrition, Université de Montréal, Montréal, Canada

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.

Comment

nature food

<https://doi.org/10.1038/s43016-023-00779-w>

Best practices for applying the Nova food classification system

Euridice Martinez-Steele, Neha Khandpur, Carolina Batis, Maira Bes-Rastrollo, Marialaura Bonaccio, Gustavo Cediel, Inge Huybrechts, Filippa Juul, Renata B. Levy, Maria Laura da Costa Louzada, Priscila P. Machado, Jean-Claude Moubarac, Tonja Nansel, Fernanda Rauber, Bernard Srouf, Mathilde Touvier & Carlos A. Monteiro

 Check for updates

The assignment of foods to one of four categories proposed by the Nova framework may be challenging in the absence of information on how these foods were prepared and their specific composition. A three-step iterative approach can make the categorization process more efficient and transparent.



Three main hypotheses on ultra-processed food (UPF) consumption

- 1. The dietary share of UPFs is increasing globally.*
- 2. Increased dietary share of UPFs has several ill-effects on the overall diet including but not restricted to unbalanced nutrient profiles.*
- 3. Increased dietary share of UPFs increases the risk of obesity, diabetes and several other chronic diseases, through various mechanisms.*

The thesis

The global displacement of traditional dietary patterns based on Nova groups 1, 2 and 3 and their culinary preparations by dietary patterns based on UPFs (Nova group 4) has been and still is a major driver of the pandemics of obesity, diabetes, and other chronic diseases and, as such, must be detained and reverted by public policies.

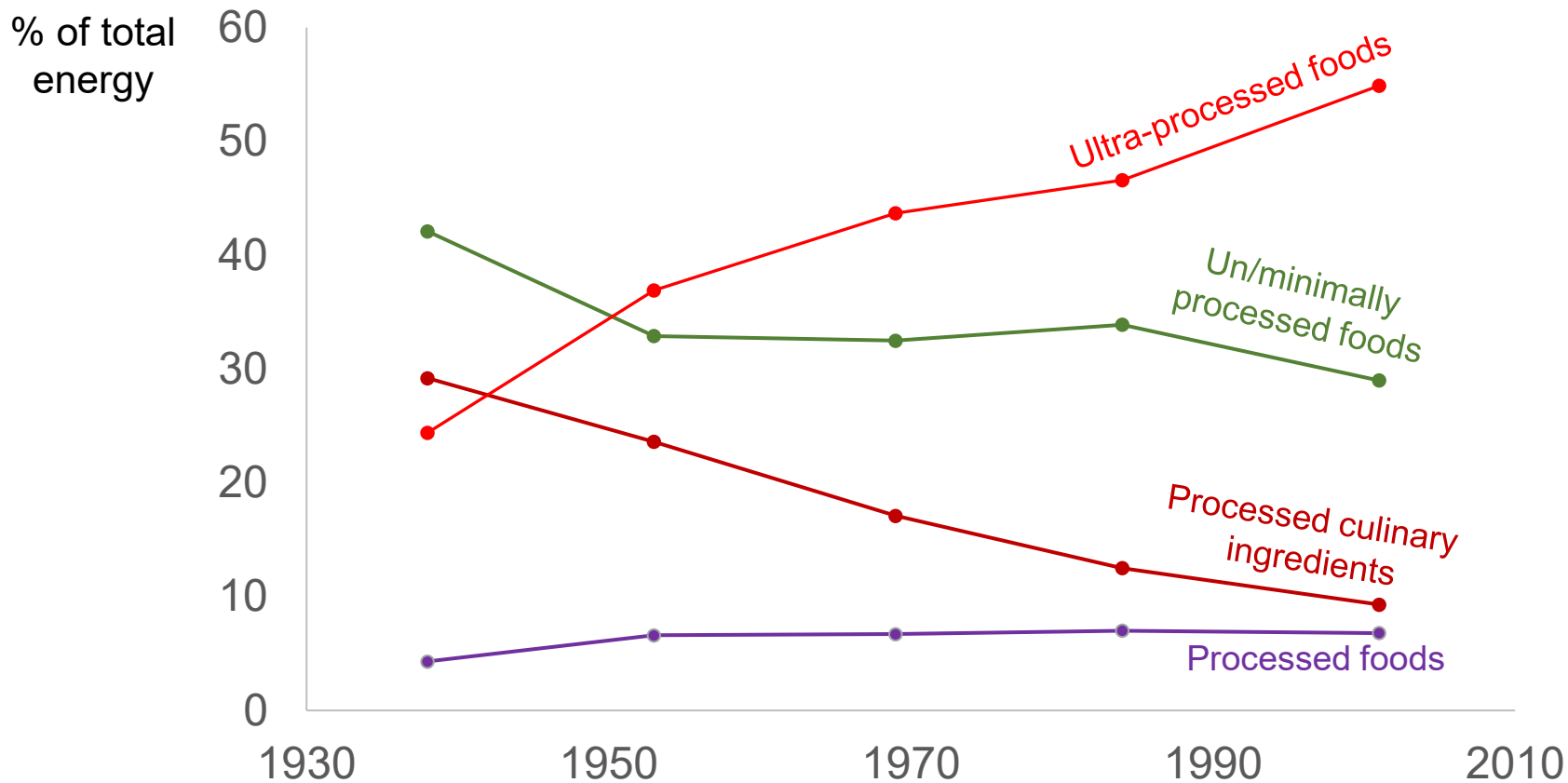
Ultra-processed foods and human health

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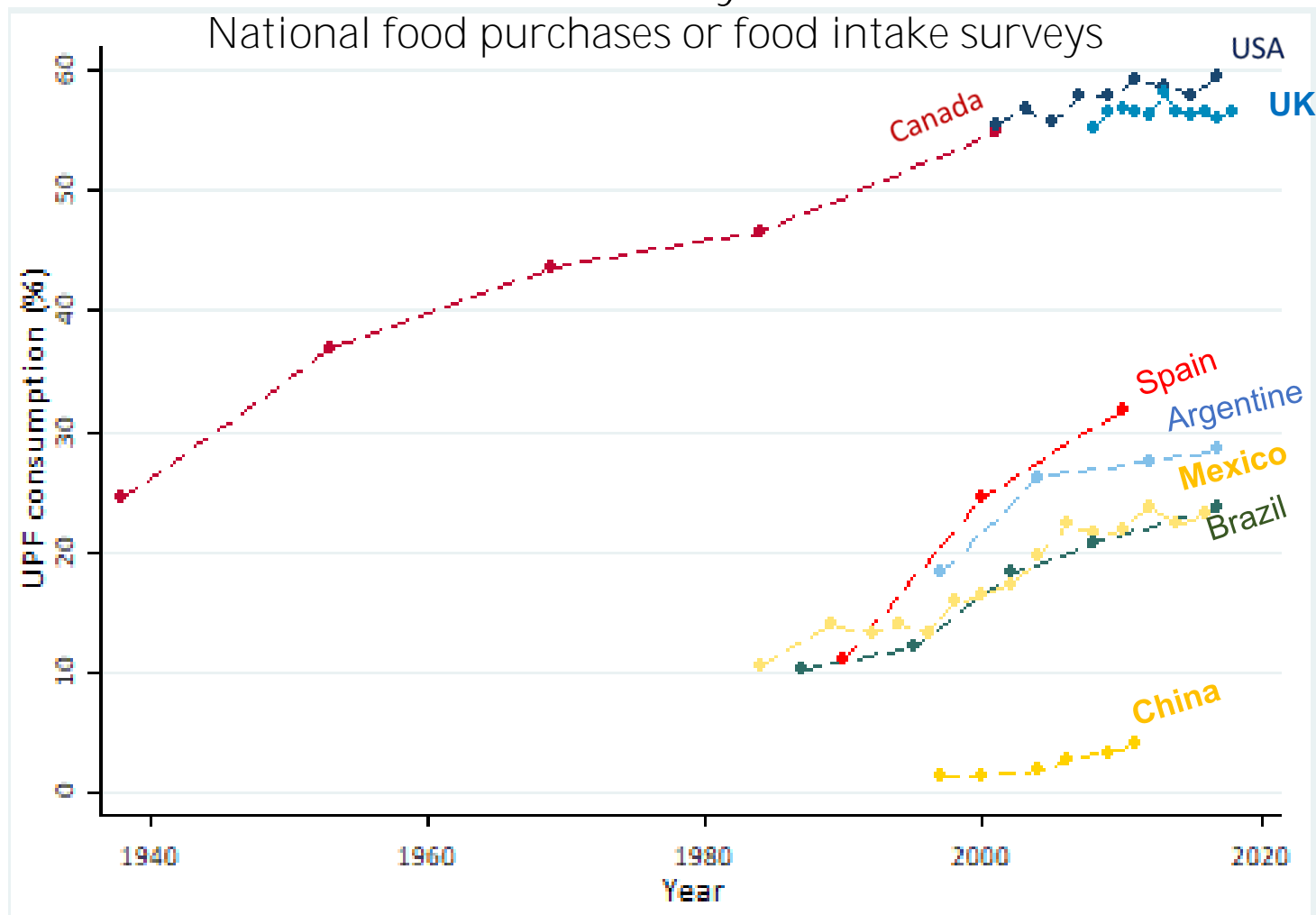
Main evidence on:

1. *The dietary share of UPFs is growing globally.*

Time trends in the estimated dietary share of Nova groups in Canada National food purchases surveys (1938-2001)



Time trends in the estimated dietary share of UPFs in 8 countries



Time trends in annual volume retail sales of ultra-processed food and drink products in 91 countries by income (2007-2022)

kg or l/person

200,0

150,0

100,0

50,0

0,0

2007 2010 2013 2016 2019 2022

LOWER-MIDDLE INCOME

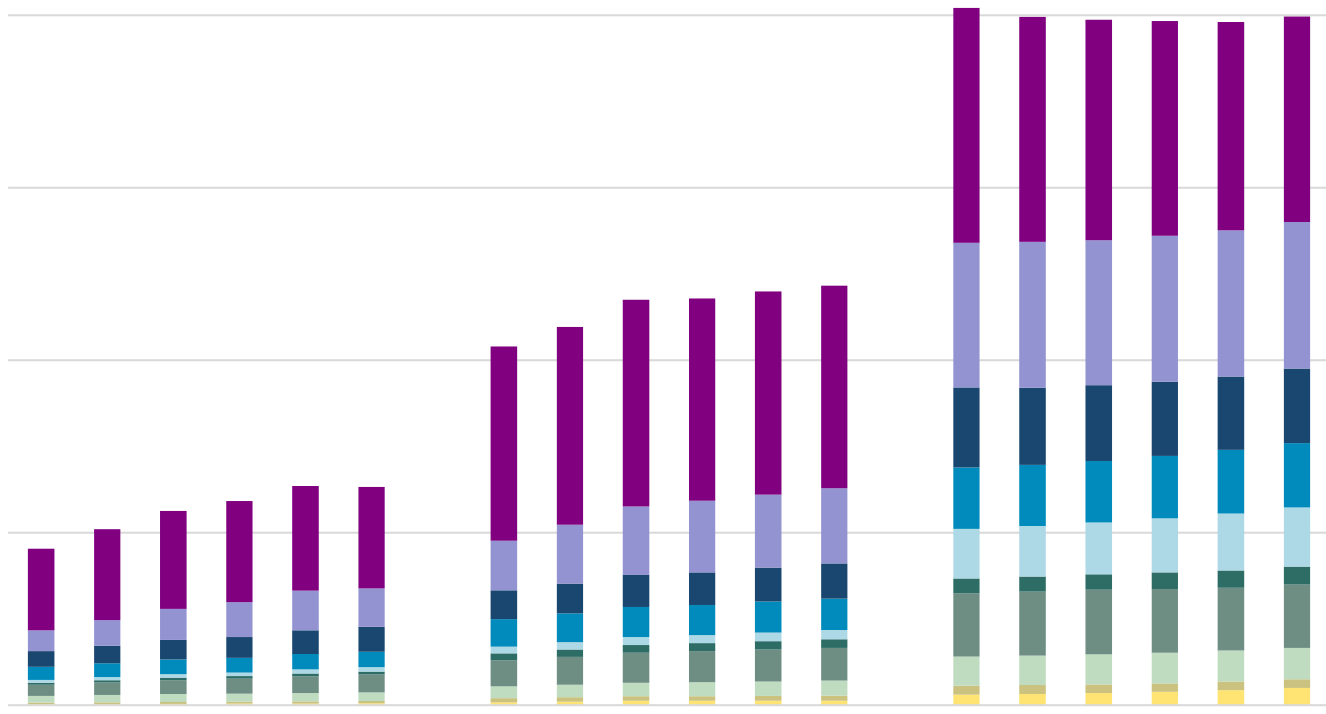
2007 2010 2013 2016 2019 2022

UPPER-MIDDLE INCOME

2007 2010 2013 2016 2019 2022

HIGH INCOME COUNTRIES

- Sweetened carbonated drinks
- Sweetened non-carbonated drinks
- Baked goods
- Sweet snacks, desserts and confectionary
- Ready meals
- Savory snacks
- Dairy products
- Sauces and dressings
- Reconstituted meat products
- Other solid foods



Main evidence on:

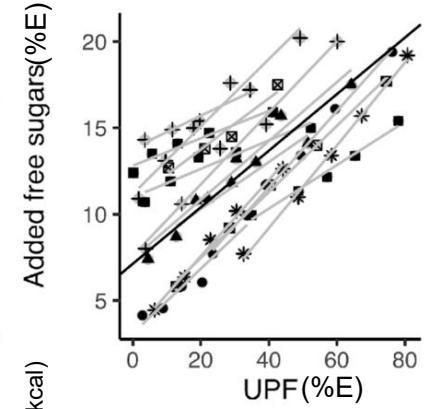
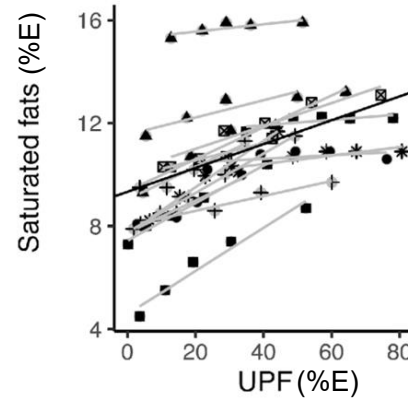
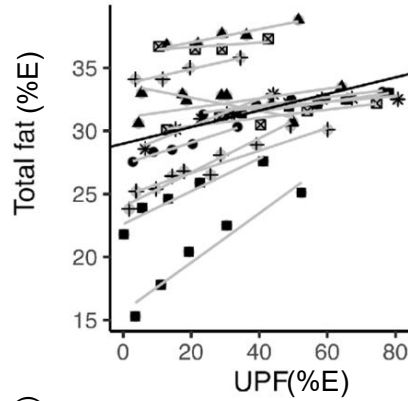
- 2. Increased dietary contribution of UPFs has several ill-effects on the overall diet including but not restricted to unbalanced nutrient profiles.*

Increases in the dietary share of UPFs deteriorates the dietary nutrient profile

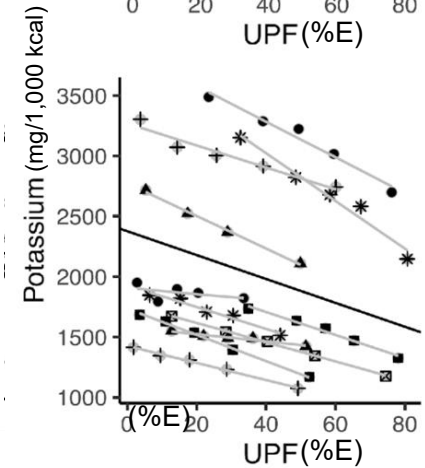
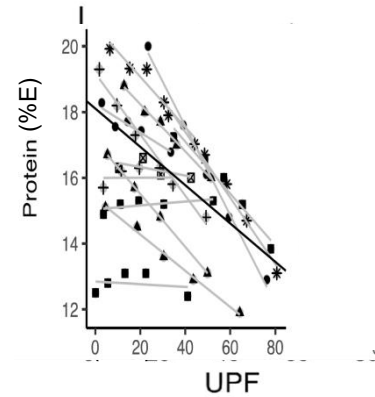
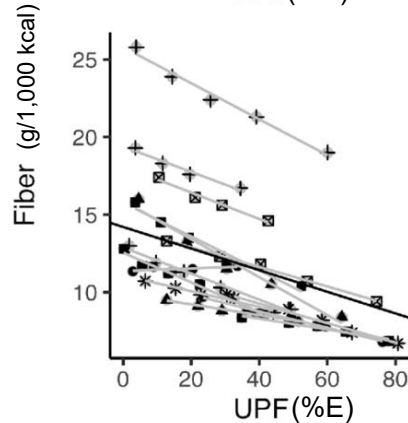
Meta-analysis of national dietary surveys in 13 countries

(Australia, Brazil, Canada, Chile, Colombia, France, Italy, Korea, Mexico, Portugal, Taiwan, the UK and the USA)

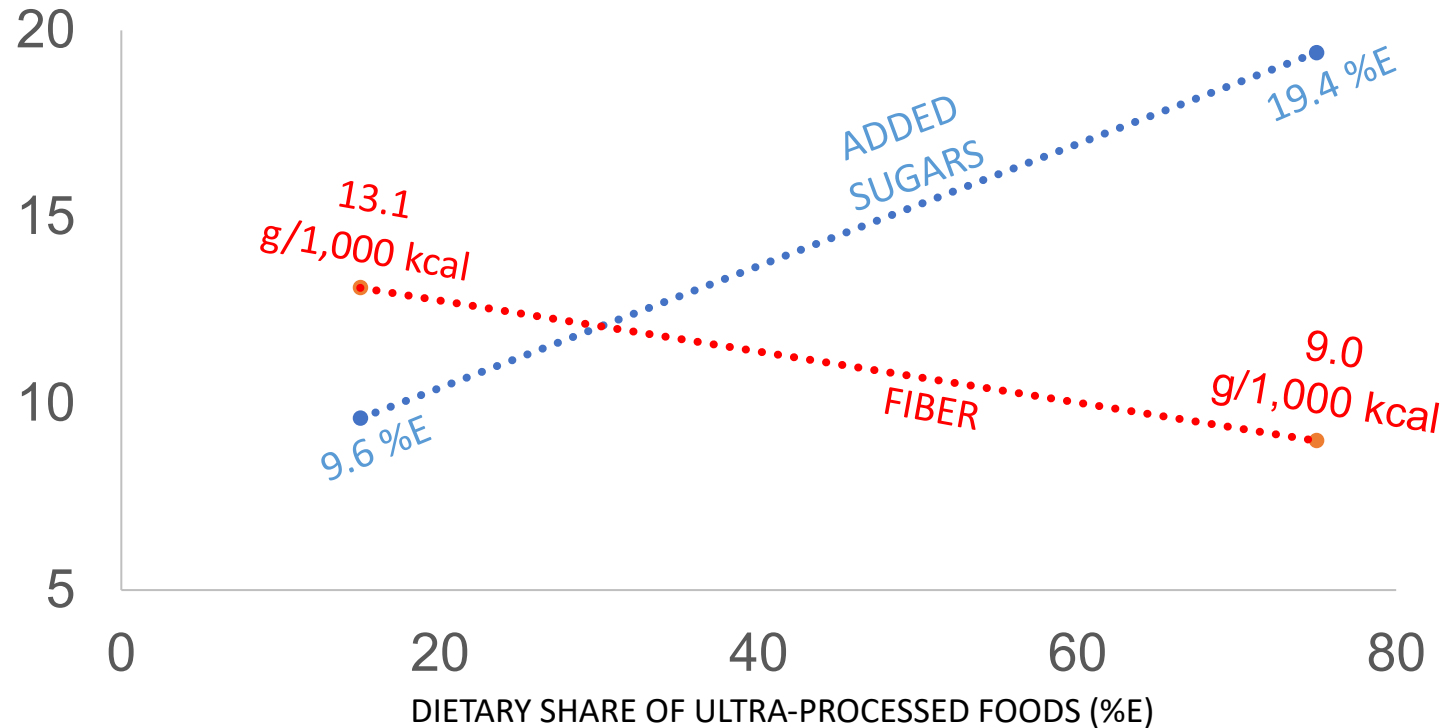
It increases
total fat, sat fat,
and added sugars



It decreases
fiber, protein,
and potassium

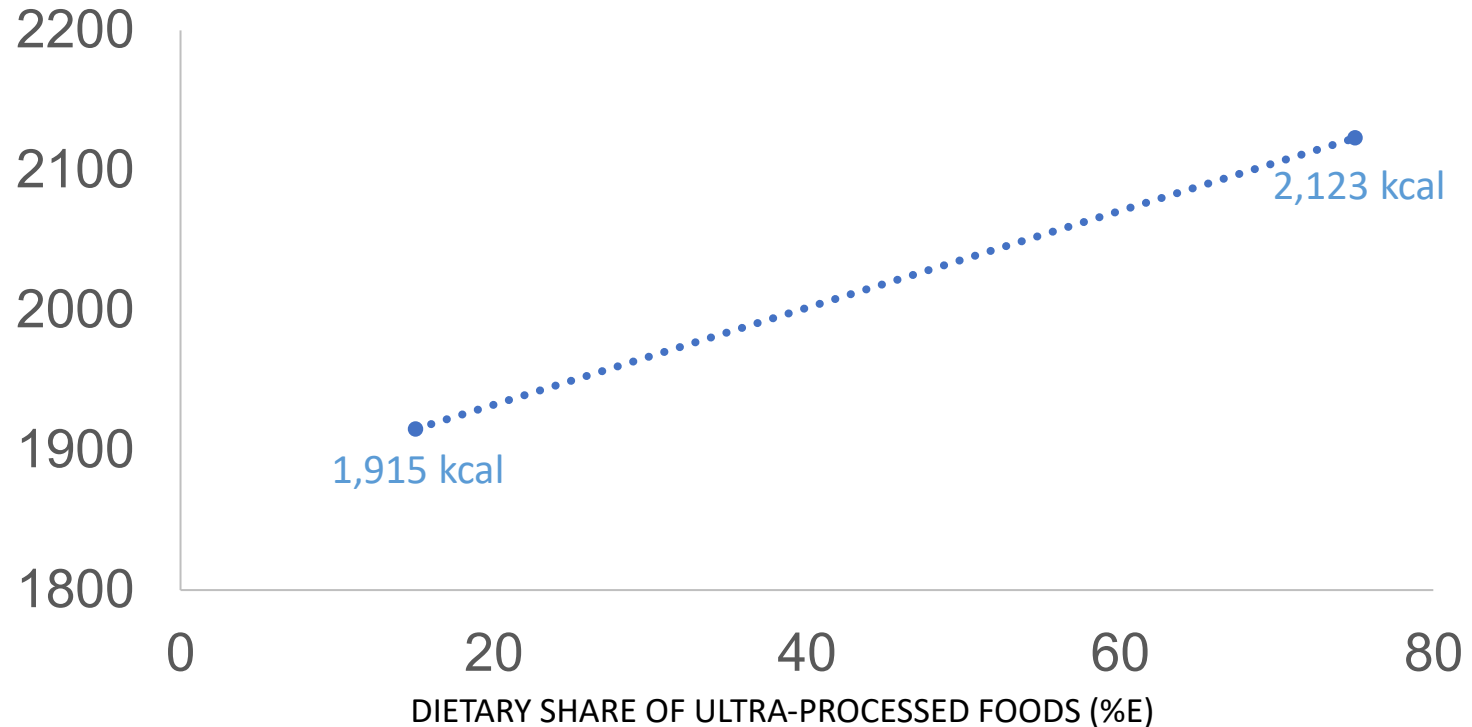


Diet content of added sugars and fiber according to the UPF dietary share as predicted by the meta-analysis of 13 national dietary surveys



Higher dietary share of UPFs is associated with higher overall energy intake

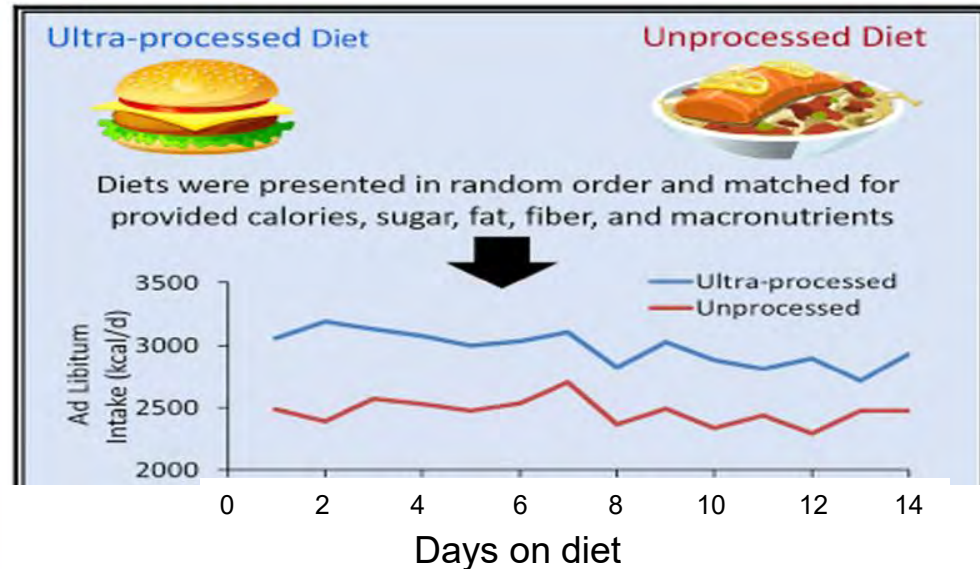
Daily energy intake according to the UPF dietary share as predicted by the meta-analysis of 13 national dietary surveys



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

Correspondence

kevinh@nih.gov

In Brief

'The ultra-processed diet caused increased ad libitum energy intake despite being matched to the unprocessed diet for presented calories, sugar, fiber, and macronutrients.'

Ad libitum meal energy intake is positively influenced by energy density, eating rate and hyper-palatable food across four dietary patterns

Received: 8 May 2022

Tera L. Fazzino^{1,2}, Amber B. Courville³, Juen Guo³ & Kevin D. Hall³ 

Accepted: 30 December 2022

Post-hoc analyses of Hall's trial: part of the higher energy intake with the ultra-processed diet could be explained by its higher content of hyper-palatable foods and higher energy density (relative to the unprocessed diet).

Evidence on ill-effects of UPF consumption on the overall diet other than deteriorated nutrient profiles and excessive energy intakes

- Reduced intake of flavonoids and phytoestrogens (Martinez-Steele 2017, 2023)
- Reduced total water intake (Baraldi et al. 2021)
- Increased intake of phthalates, bisphenol A, acrylamid (Martinez-Steele et al. 2019, 2023)
- increased intake of emulsifiers, flavor enhancers, artificial sweeteners, and colorants (Sour et al. 2023)
- Addictive-like eating (Gearhardt 2021) and pro-inflammatory gut microbiota diet (Zinocker 2018, Srour et al 2022)

Main evidence on:

- 3. Increased dietary contribution of UPFs increases the risk of obesity, diabetes and other diet-related chronic diseases, through various mechanisms.*

More than 70 cohort studies*, adjusted for a broad range of potential confounders, have shown prospective dose-response associations between increased UPF intake and 20 health outcomes (**obesity, visceral adiposity, increased adiposity from childhood to early adulthood, type 2 diabetes, hypertension, dyslipidemias, hyperuricemia, gout, coronary heart disease, cerebrovascular disease, all cancers, breast cancer, colorectal cancer, non-alcoholic liver disease, Crohn's disease, ulcerative colitis, chronic kidney disease, depression, dementia, and all-cause mortality**).

*Cohorts included NutriNet Santé, SUN Navarra, EPIC, Predimed, UK Biobank, UK ALSPAC, ENRICA Spain, Moli-sani Italy, Lifelines Netherlands, PURE, Harvard, Framingham, ARIC, Nhanes follow-up, ELSA Brazil, CHNS China ...

Main evidence on:

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Review

The Role of Diet Quality in Mediating the Association between Ultra-Processed Food Intake, Obesity and Health-Related Outcomes: A Review of Prospective Cohort Studies

Samuel J. Dicken ¹ and Rachel L. Batterham ^{1,2,3,*}

¹ Centre for Obesity Research, Department of Medicine, University College London (UCL), London WC1E 6JF, UK; samuel.dicken.20@ucl.ac.uk

² Bariatric Centre for Weight Management and Metabolic Surgery, University College London Hospital (UCLH), London NW1 2BU, UK

³ National Institute for Health Research, Biomedical Research Centre, University College London Hospital (UCLH), London W1T 7DN, UK

* Correspondence: r.batterham@ucl.ac.uk

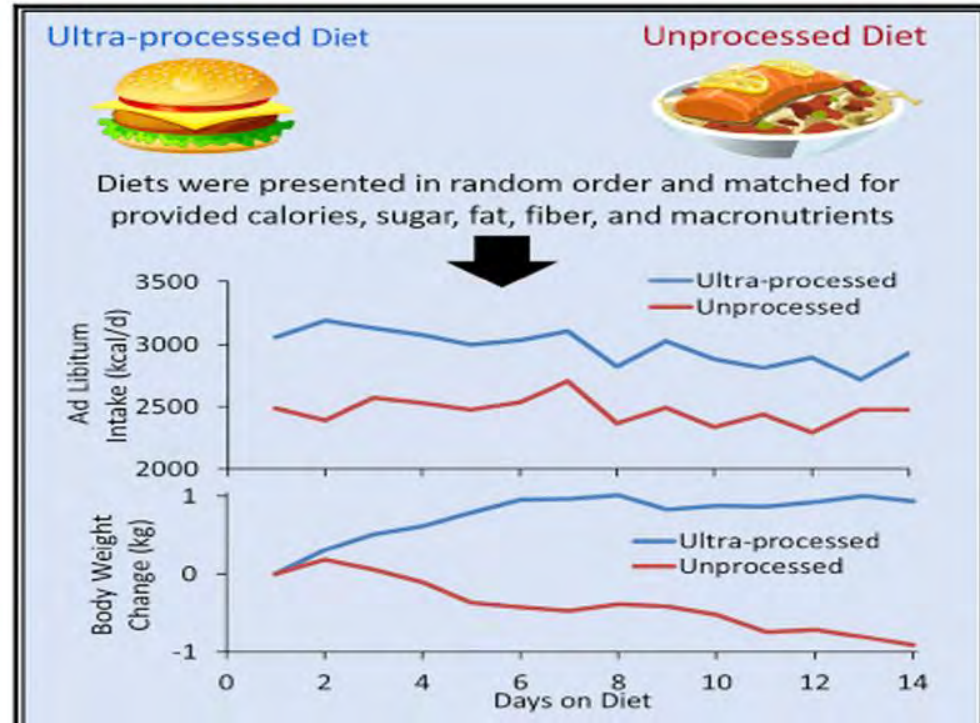
‘Consistent across many studies, adjustment for fat, sugar and sodium intake, or adjustment for adherence to a range of healthy or unhealthy dietary patterns has a minimal impact on the adverse associations between UPF intake and a diverse range of health-related outcomes.’



Cell Metabolism

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

Graphical Abstract



In line with Dicken & Batterham review of 37 cohort studies and with the analysis from the Moli-sani cohort study

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Ad libitum meal energy intake is positively influenced by energy density, eating rate and hyper-palatable food across four dietary patterns

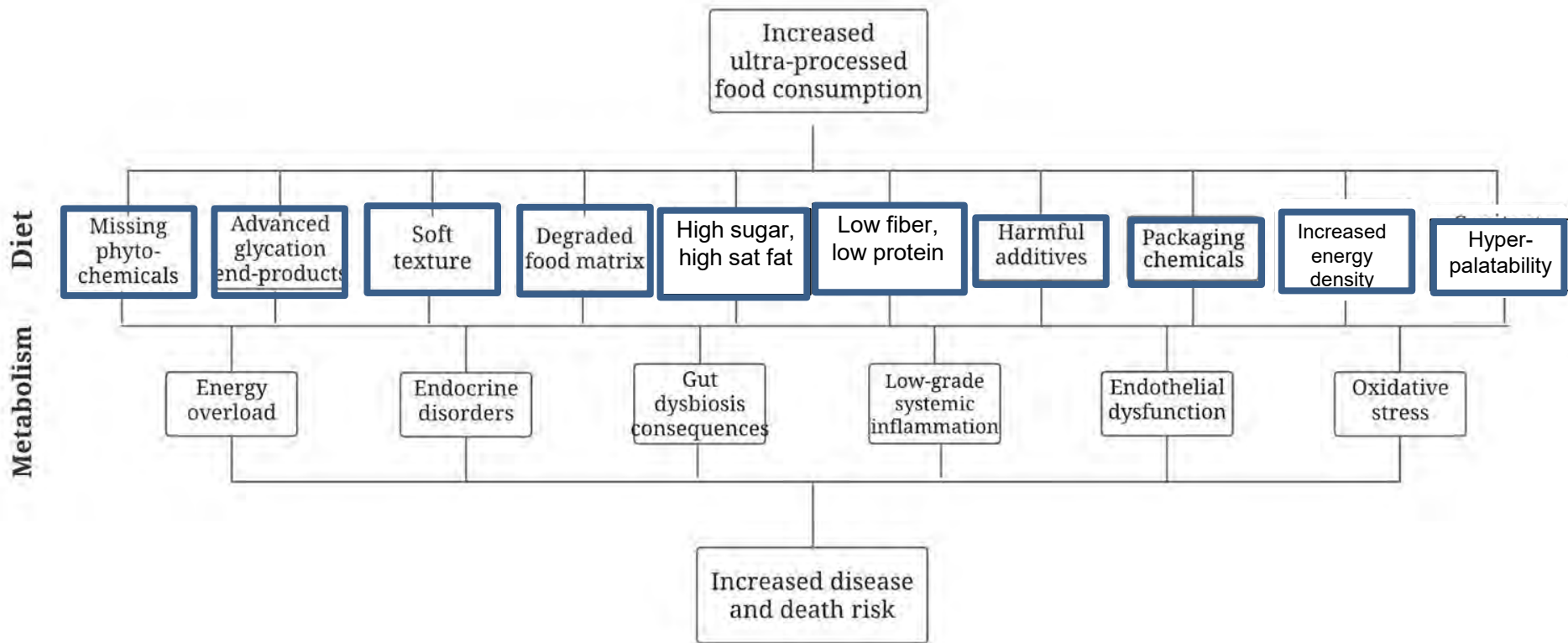
Received: 8 May 2022

Tera L. Fazzino^{1,2}, Amber B. Courville³, Juen Guo³ & Kevin D. Hall³ 

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Post-hoc analyses of Hall's trial: part of the higher energy intake with the ultra-processed diet could be explained by its higher content of hyper-palatable foods and higher energy density (relative to the unprocessed diet).

Different combinations of mechanisms link UPF to different diseases



Do we need to know the exact combination of mechanisms that link UPF to each disease before recommending for people to reduce or avoid its consumption and for policy makers to implement actions to make this feasible?



Commentary

Ultra-processed foods and the limits of product reformulation

Gyorgy Scrinis^{1,*} and Carlos Augusto Monteiro²

¹Faculty of Veterinary and Agricultural Sciences, University of Melbourne, Building 142, Parkville, Melbourne, VIC 3010, Australia; ²Department of Nutrition, School of Public Health, University of São Paulo, São Paulo, Brazil

Submitted 31 October 2016; Final revision received 2 May 2017; Accepted 25 May 2017

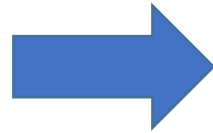
Abstract

The nutritional reformulation of processed food and beverage products has been promoted as an important means of addressing the nutritional imbalances in contemporary dietary patterns. The focus of most reformulation policies is the reduction in quantities of nutrients-to-limit – Na, free sugars, SFA, *trans*-fatty acids and total energy. The present commentary examines the limitations of what we refer to as ‘nutrients-to-limit reformulation’ policies and practices, particularly when applied to ultra-processed foods and drink products. Beyond these nutrients-to-limit, there are a range of other potentially harmful processed and industrially produced ingredients used in the production of ultra-processed products that are not usually removed during reformulation. The sources of

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Learning from successful policies to fight tobacco use



British Conservative Party politician, who served as Leader of the Conservative Party, asks for UPF to be treated as tobacco



Start treating ultra-processed food like tobacco

History will look back at our salt and sugar-laden diet — and the government resistance to curbing it — with incredulity

[William Hague](#) | Monday June 19 2023, 5.00pm BST, The Times

Learning from successful public actions to fight tobacco use

PUBLIC ACTIONS RELATED TO:	FIGHTING TOBACCO	FIGHTING UPF
Providing reliable information to the population	MoH-oriented mass-media campaigns on the health consequences of smoking, supported by medical societies and champions/influencers	Similar campaigns on the health consequences of consuming UPF and the benefits of fresh/minimally processed foods (review of national DG)

Dietary guidelines that already recommend UPF avoidance or reductions



UPF avoided or reduced

Circulation

The Lancet Commissions

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, MNSP, 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 and Stroke Epidemiology; Council on Clinical Cardiology; Council on Nutrition, Physical Activity, and Obesity

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

Tam 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-Hernández, Cyniel Y Pansiera, Britney Sheena, Aileen Lerouge, Marion Devaux, Nick Scott, Margaret Hellard, Henkjan J Verkade, Ekkehard Sturm, Giulio Marchesini, Hannalee Yki-Jarvinen, Chris D Byrne, Giovanni Targher, Aviad Tur-Sinai, Damon Barnett, Michael Nimburg, Tatjana Reic, Alison Taylor, Tim Rhoads, Carla Trellaor, Claus Petersen, Christoph Schramm, Robert Flivaik, Maneta Y Simoniou, Albert Pares, Philip Johnson, Alessandria Cocchetti, Isabel Graupera, Cristos Llorens, Elissa Pose, Nùria Fabrellas, Ann T Ma, Juan M Mendieta, Vincenzo Mazzaferro, Harry Rutter, Helena Cortez-Pinto, Deirdre Kelly†, Robyn Burton, Jeffrey V Lazarus†, Pere Ginès†, Maria Butri†, Philip N Newsome††, Patrizia Burra††, Michael P Manns††

Executive summary
Liver diseases have become a major health threat across Europe. This Commission recommends a multi-level approach to care using multilevel interventions acting on current and future risk factors.



Learning from successful public actions to fight tobacco use

PUBLIC ACTIONS RELATED TO:	FIGHTING TOBACCO	FIGHTING UPF
Providing reliable information	MoH-oriented mass-media campaigns on the health consequences of smoking, supported by medical societies and champions/influencers	Similar campaigns on the health consequences of consuming UPF and the benefits of fresh/minimally processed foods (review of national DG)
Avoiding disinformation and incentives to unhealthy behaviours	Tobacco advertisements prohibited	UPF advertisements prohibited or heavily restricted
	Tobacco front-of-package warnings	UPF front-of-package warnings
Creating healthy environments	Prohibition of tobacco sales in schools and health facilities	Prohibition of UPF sales in schools and health facilities
	Tobacco-free settings	UPF-free schools and health facilities
	Heavy taxation of cigarettes and use of revenues to promote health	Heavy taxation of UPF and use of revenues to subsidize fresh foods

Many thanks!

Merci à tous!