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Scientific critique of 'ultra-processed foods' (UPFs) classifications

IN BRIEF

The level of processing our food and drink undergoes does not determine the nutritional content of the final product.

Classifying and legislating food on the basis of the level of processing is not a scientifically-sound approach to food policy and would lead to negative outcomes for our food systems.

FoodDrinkEurope has undertaken a review of over 40 independent academic and scientific papers that critique 'ultra-processed foods' (UPFs) classifications and highlighted the main arguments in this paper.

FoodDrinkEurope has not financed, commissioned, or participated in any of this research. Full references and citations are available throughout.

Summary

Below we present a collection of counterarguments to the use of classifications based on levels of processing, such as NOVA or SIGA, as a basis of food policy or food regulation. Each argument is derived from independent, peer-reviewed academic and scientific research. We also provide links to recent key reviews which are open access.

Bookmarks to counterarguments based on 3 themes:

- **Criticisms of the current classifications schemes based on whether and to what extent they can inform food policy or dietary guidance i.e. are they fit for purpose ?**
  - *The classification schemes fail to meet important criteria required for dietary recommendations*
  - *Classifications are ideologically biased*
  - *Classifications are too broad and inclusive and not based on scientific evidence*
  - *Lack of clear objective definitions, non-validated dietary intake methods, and risk of divergent classification*
  - *No universally accepted classification scheme or definitions*
  - *Lack of quantitative cutoffs*
  - *Lack of consumer perception data which leads to poor understanding of food processing*
  - *Use of sensationalist and pejorative terminology risks bias*
  - *Critics of the scheme subject to industry bias*

- **Criticisms of classifications based on the scientific evidence for effects of consuming UPFs on health outcomes**
  - *Most of the evidence is based on epidemiological studies which are likely biased by confounding and reverse causality*
  - *Results of epidemiological studies likely biased by nutrients, energy, diet quality and dietary patterns*
  - *Results of systematic reviews subject to high risk of bias and flawed reporting quality*
  - *Not all processed foods or patterns of UPF consumption are adversely associated with health outcomes*
  - *Any classification based on or including elements of 'processing' should be supported by strong scientific evidence with clear mechanisms*
  - *Are there any underlying food 'processing' mechanisms, independent of diet quality, which may be having an effect on energy intake and health outcomes?*
  - *Further evidence needed on whether any effects of food processing act via effects on palatability and tastes*
  - *Further evidence is needed on whether any effects of food processing act via effects on food texture and matrices*

- **Criticisms of the classifications based on the potential harm from using the classifications in nutrition policy**
  - *Risk of policy makers developing policies based on lower quality evidence*
  - *Negative effects on population health*
  - *Assumption that culinary preparations and traditional foods are necessarily healthier*
  - *Dismissal of established knowledge*
  - *Lack of recognition of benefits of reformulation*
  - *Misleading information to consumers that all added ingredients, food additives and contaminants are harmful and are only found in UPFs*
  - *Wider effects of focussing policy on UPFs*
  - *NOVA classification could hamper relevant innovations in sustainable solutions*

Links to key recent reviews on the topic:

- O'Connor et al., (2023) Perspective: A research roadmap about ultra-processed foods and human health for the United States Food System: Proceedings from an interdisciplinary, multi-stakeholder workshop
- Forde (2023) Beyond ultra-processed: considering the future role of food processing in human health
- Gibney and Forde (2022) Nutrition research challenges for processed food and health
- Sadler et al., (2021) Processed food classification : Conceptualisation and challenges

Criticisms of the current classifications schemes based on whether and to what extent they can inform food policy or dietary guidance i.e. are they fit for purpose?

The classification schemes fail to meet important criteria required for dietary recommendations.

The design of any food processing classification scheme needs to consider its intended policy use (Gibney and Forde, 2022). Classifications schemes, such as NOVA, fail to demonstrate the criteria required for successful dietary recommendations: understandability, actionable, affordability and safety (Jones, 2019). There is an emerging consensus that classifications based on processing, such as NOVA, are not fit for purpose i.e. to inform food policy or provide dietary guidance (Sadler et al., 2021; Gibney and Forde, 2022; Forde, 2023a).

Classifications are ideologically biased

Classifying foods according to their assumed '*purpose*', including their design to be, for example, '*highly profitable*', '*intensely appealing*' or '*convenient*' is subjective and has been suggested to reflect an ideological bias against modern food production systems (Forde, 2023b; Visioli et al., 2022). There is no evidence that foods which are unprofitable, unpalatable, expensive or inconvenient are linked to better health outcomes (Forde, 2023b)

Classifications are too broad and inclusive and not based on scientific evidence

The classifications are diverse, based on the extent and nature of change in a food from its original form, including changing inherent properties of foods, the addition of ingredients, as well as considering the place of processing, and the purpose of processing. Furthermore, the classifications seem to assume that most food processing is deleterious for health, and are hypothesis driven rather than derived from strong scientific evidence i.e. studies using NOVA to support claims made by the NOVA classification itself may represent a circular argument (Sadler et al., 2021).

Without scientific evidence for adverse effects of specific ingredients or processing methods, the ultra-processed category may be too broad and inclusive - covering a high proportion of energy sources (up to 60% in some developed countries) and approximately ten to twelve different food groups with a wide and diverse nutrient composition (Forde, 2023a, 2023b).

Lack of clear objective definitions, non-validated dietary intake methods, and risk of divergent classification

Classifications based on processing have been criticised by many as being vaguely defined and/or not objective and thus open to interpretation (Braesco et al., 2019; Gibney et al., 2017; Thielecke et al., 2020; Vergeer et al. 2019; Visioli et al., 2023; Weaver et al., 2014).

The classification schemes post-date most methods of estimating dietary intake (usually with food-frequency questionnaires and 24-hr dietary recall), which have not been specifically validated for estimating processed food intake and are often applied on a post-hoc basis i.e. without adequate information to classify products. In addition, existing food composition databases do not contain complete information on ingredients or processing of foods (Sadler et al., 2021). Thus, such data should be considered with caution (Marino et al., 2021, Capozzi et al., 2021).

Due to the subjective nature of the classification schemes and caution regarding the validity of dietary assessment of processed intake, there is a high risk of discrepancies in classifying foods by researchers and consumers (Poti et al., 2017; Braesco et al., 2019). Few studies report adequate detail on the method used to classify foods or the level of agreement between coders (Forde, 2023b). Consistency in classification has been shown to be low in one study on food and nutrition experts (Braesco et al., 2022) as well as in consumers (Ares et al., 2016).

Consumers' confusion about definitions and food categorisations, inadequate cooking and meal planning skills and scarcity of resources (time, money), can all impact on healthy food selection and preparation (Jones, 2019; Tobias et al. 2021, Estell et al., 2022, Petrus et al., 2021).

No universally accepted classification scheme or definitions

Several classification schemes have been proposed and used to classify foods by various degrees to which they are processed (Gibney and Forde, 2022, Sadler et al., 2021). A universally accepted definition of high or ultra-processed foods is lacking, highlighting the different perspectives on which food properties are considered to affect the degree of food processing. The schemes are inconsistent in their associations with nutrients which form the basis of most nutrition guidelines (Gibney and Forde, 2022). The different schemes are also inconsistent in their associations with health outcomes (Forde 2023b), which suggests the basic concept of high or ultra-processing of foods is unlikely to be the major explanatory factor responsible (Visioli et al., 2023). Any definitions and schemes should be based on scientific evidence in relation to any impact of food processing on health and thus better aligned on health outcomes.

In addition, the term ‘ultra-processed food’ lacks congruence with legal or food science definitions relating to food processing (Jones, 2019), and does not meet the criteria established for the terms “processing” and “processed foods” by Regulation (EC) No 852/2004 on the hygiene of foodstuffs (FoodDrinkEurope comment).

Lack of quantitative cutoffs

The categorisations consider that inclusion of any amount of ingredient, whether it is a nutrient or additive, is harmful independent of its amount. For nutrients, this approach fails to consider the specificity of effects, both in terms of nutrient and amount, that is supported by scientific evidence. Whilst, for additives this approach ignores the legality and regulation of their safe addition to foods (Gibney, 2017).

Lack of consumer perception data which leads to poor understanding of food processing

Little is known regarding consumer understanding, and implementation of classifications based on processing (Jones, 2019). Studies have reported inconsistent results with some participants perceiving processed food culinary ingredients and even some minimally processed foods as UPFs (Ares et al., 2016, Sadler et al., 2021). Confusion may arise from conflicting messaging relating to the processed nature of a product versus its nutritional quality (Braesco et al., 2019). Conflict and disagreement among professionals could sow doubts and amplify consumer confusion about this topic, leading to either (a) amplified or attenuated perception of risk; (b) loss of trust; (c) rejection of any messages (Sadler et al., 2022). Classifying foods, including culinary ingredients, together with no distinction based on their nutritional value (e.g. saturated fat content) does not help consumers to choose healthier products.

Use of sensationalist and pejorative terminology risks bias

Processed and ultra-processed foods are often presented using pejorative terminology (Jones, 2019). The prefix '*ultra*' suggests there is a norm for what is deemed a reasonable or acceptable amount of processing, for which there is no consensus (Sadler et al., 2022). Use of highly subjective and value-laden terms, including references to '*natural*' and '*convenience*', may not be helpful for consumer understanding when used to imply the level of healthfulness (Sanders et al. 2021). There is little evidence to support '*hyperpalatability*' as a distinct phenomenon from '*palatability*' (Gibney et al., 2017), and obesity is not reliably associated with a heightened hedonic response to specific foods (Forde, 2023b). Use of such terms to explain any effects on weight or health, as well as definitions based on addition of caloric nutrients, have been suggested to be based on circular arguments (Forde, 2023b; Jones, 2019).

Critics of the scheme subject to industry bias

Proponents of the classification have suggested that critics are subject to industry bias. (Sadler et al., 2021). However, the converse should also be noted, i.e. proponents may be subject to an anti-industry bias (Forde, 2023a).

Criticisms of classifications based on the scientific evidence for effects of consuming UPFs on health outcomes

Most of the evidence is based on epidemiological studies which are likely biased by confounding and reverse causality

Results of observational studies are subject to residual and unmeasured confounding. Authors have reported clear differences in a wide range of demographic, socioeconomic and behavioural characteristics between high and low UPF consumers (Zhang and Giovannucci, 2023). For example, in one study higher UPF consumers were younger, with higher BMI, lower socio-economic status, undertaking less physical activity, and with total intakes of energy, sodium, carbohydrate and total fat increasing with increasing UPF consumption (Chang et al., 2023). These factors, in addition to factors not measured or reported in such studies, impact upon the results of observational studies.

Results may also be subject to reverse causality. i.e. where people with or at greater risk of disease consume more foods considered to be 'processed' or 'ultra-processed', rather than the converse (Poti et al., 2017, Sadler et al., 2021).

Results of epidemiological studies likely biased by nutrients, energy, diet quality and dietary patterns

The classification of UPFs includes foods with added sugars, fats and salt, and the highest proportion of UPFs consumed by European adults would be considered as foods to discourage under current nutrient-based dietary guidelines (Mertens et al., 2022). It is therefore not surprising that this category is linked to adverse health outcomes and associations are likely biased (Forde, 2023b). Results of observational studies which have attempted to control for nutrient intake or diet quality are inconsistent regarding health risks of UPFs (Gibney and Forde 2022; Forde 2023b). Further research is needed to understand if or to what extent any associations between UPFs and body weight or health outcomes is confounded by the energy and/or nutrient content of the classified foods, or indeed dietary patterns or other confounding factors (Gibney and Forde 2022, Forde 2023b). Information on diet is usually only measured at baseline in cohort studies with long-term follow-ups, whereas dietary intake, including formulation of foods may have changed over time, limiting interpretation of results (Zhang and Giovannucci, 2023).

Given the small size of associations, the risk of confounding and the impossibility of correcting for all confounders there is a need to move away from observational evidence which cannot establish causality to higher-quality controlled feeding studies to establish whether the relationship between UPF consumption and health is independent of diet quality (Forde 2023a; Visioli et al., 2022). Any addition of elements of processing to nutrient-based classification schemes should be based on strong scientific evidence.

Results of systematic reviews subject to high risk of bias and flawed reporting quality

A review of systematic reviews investigating associations between UPF consumption and health outcomes reported a high risk of bias and flawed reporting quality which required significant improvement in order to more reliably inform health policies (Wang et al., 2023).

Not all processed foods or patterns of UPF consumption are adversely associated with health outcomes

An increasing number of observational studies show inconsistent associations (some positive, others negative) between intake of sub-categories of UPFs or specific dietary patterns of UPF consumption and health outcomes, which would suggest that the overall concept for an UPF-based classification is flawed (Chen et al., Cordova et al., 2023; Duan et al., 2022; Samuthpongtorn et al., 2023; Taneri et al., 2022). Based on scientific evidence and consensus, some processed foods and UPFs are recommended in dietary guidelines around the world (Estell et al., 2022; Visioli et al., 2022). Removal of foods or advising against consumption of food groups which are considered UPF but are associated with reduced risk of a health outcome could pose a risk to health (Forde, 2023b). Sub-categories of foods adversely associated with health outcomes are considered to be already covered by nutrient or food-based dietary guidelines (SACN, 2023; NNR 2023).

Any classification based on or including elements of 'processing' should be supported by strong scientific evidence with clear mechanisms.

Only a single randomised controlled trial has been undertaken to date (Hall et al., 2019) indicating ad libitum consumption of a diet high in UPFs may cause greater energy intake and weight gain, compared to a diet low in UPFs. Further studies are warranted to repeat the findings whilst addressing the study limitations and inform on specific properties of processed foods that may result in adverse health outcomes (Forde, 2023b).

To this end and to better inform dietary guidance, research priorities have been proposed (Gibney and Forde, 2022; O'Connor et al., 2023) to:

- improve categorisation of UPFs, assessment of their exposure, and assessment of risk independent of diet quality ;
- identify what, if any, attributes of UPFs influence ingestive behaviour and/or contribute to clinically meaningful metabolic responses; and
- understand what, if any, external environmental factors lead people to consume high amounts of UPFs.

It has also been proposed that research priorities need to be framed against a backdrop of rising food insecurity, including food costs and impact on the environment (Forde, 2023a).

Are there any underlying food 'processing' mechanisms, independent of diet quality, which may be having an effect on energy intake and health outcomes?

There is currently no single mechanism which can explain associations between consuming UPFs and the diverse range of health outcomes reported in the literature, which presents a research challenge (Forde, 2023b). Numerous factors are known to influence energy intake including but not limited to eating rate, protein content, energy density, and oro-sensory properties such as texture and palatability (Sadler et al., 2021; Fazzino et al., 2022). Further research is needed to uncover which, if any of these factors, are responsible for any effect in addition to any possible role of non-nutritive components, such as additives, on metabolic outcomes (Forde 2023b).

Further evidence needed on whether any effects of food processing act via effects on palatability and tastes.

There is no clear evidence for a heightened hedonic response when consuming UPFs (Forde, 2023b), and current research does not support that the palatability of processed foods drives overconsumption (Hall et al., 2019). However, there is some secondary evidence that certain pairings of nutrients, termed '*hyperpalatable*' (fat and sugar, fat and sodium, carbohydrates and sodium) may be associated with ad libitum energy intake when they exceed objective thresholds (Fazzino et al., 2022). Further research is being undertaken which will inform on this concept.

There is also no clear empirical evidence from clinical trials for a disproportionate contribution of specific tastes of ultra processed foods in promoting excessive daily energy intakes (Teo et al., 2022a, Gibney and Forde, 2022). Although there is some evidence that certain taste combinations may be associated with indices of body weight, this evidence does not include reference to whether the foods would be considered 'processed' or not (Teo et al., 2022a; van Langeveld et al., 2018) and 'taste-nutrient' relationships appear to be maintained across categorisations of processed foods (Teo et al., 2021). Other preliminary evidence suggests the degree of processing of the diet (as indicated by NOVA classification), did not appear to alter salt and sweet taste preferences and sensitivity (Jaime-Lara et al., 2023).

A rigorous appraisal of the evidence relating to food processing impacting on food palatability and/or affecting taste-nutrient signals and thereafter food intake is needed (Gibney and Forde, 2022).

Further evidence is needed on whether any effects of food processing act via effects on food texture and matrices.

The concept for the effects of disruption of food matrices in UPFs on health requires further research, though it should be noted that effects on food matrices can be beneficial or unfavourable (Braesco et al., 2019). Results of recent intervention studies support that hard vs. soft textured food results in lower food and energy intake, with slower eating rates, independent of processing level, energy density and palatability (Teo et al., 2022b; Lasschuijt et al., 2023). In the sole study where an UPF diet resulted

in higher energy intake, the rate of energy intake was higher in the UPF vs. the unprocessed condition (Hall et al. 2019), which may result from differences in texture and/or energy density of foods selected on each diet. Further research is underway which should inform on this concept and whether foods can be processed to decrease the rate of energy intake.

Criticisms of the classifications based on the potential harm from using the classifications in nutrition policy.

Risk of policy makers developing policies based on lower quality evidence.

There is a lack of consensus as to what features determine the level of food processing (Jones, 2019; Sadler et al., 2022). Some dietary guidelines, initially in Brazil and now in other countries, refer to food processing and advise avoiding/limiting UPF consumption. However, other scientific advisory organisations consider the current evidence should be viewed with caution due to uncertainties regarding the quality of the evidence (SACN, 2023), and with observed associations considered to be already covered by existing nutrient and food-based recommendations (SACN 2023, NNR, 2023).

Negative effects on population health.

Removing or reducing UPFs, including those with an acceptable nutritional quality, may have negative effects on population health (Jones, 2019; Forde, 2023b). Nutrient-dense products such as whole-grain foods and dairy products – both of which may be fortified – can be found within the UPF category. Mandatory fortification of specific foods has improved nutrient intakes in populations and yet all foods with added nutrients are considered UPFs (Estell et al., 2022; Forde, 2023b). Avoidance of UPFs could decrease intakes of wholegrains, dietary fibre and certain micronutrients such as thiamine, folate, calcium and iodine (Estell et al., 2022; Jones 2019, Thielecke et al., 2020).

A recent study showed that a carefully chosen dietary pattern, even when predominantly based on UPF, could achieve a high diet quality score, in excess of the population average diet quality score, and contain adequate amounts of most macro- and micronutrients (Hess et al., 2023).

Assumption that culinary preparations and traditional foods are necessarily healthier.

It is not known whether the processing of foods or the ‘ultra-processed’ versions of composite foods are of lower nutritional quality or affect health outcomes differentially versus their home-cooked or processed counterpart (Sadler et al., 2021; O’Connor et al., 2023). Some research has identified home recipes as less healthy than their ultra-processed counterpart, and not all ‘traditional’ foods, which are favoured in some classifications based on processing, are ‘healthy’ (Sadler et al., 2021). Classifying foods based on ‘*place*’ or ‘*person*’ is misleading and may have consequences.

Dismissal of established knowledge

Classifications based on 'processing' dismisses decades of nutrition research showing relationships between nutrients, foods, dietary patterns and health, which forms the basis for nutrition guidelines worldwide (Gibney et al., 2017; Forde, 2023b).

Lack of recognition of benefits of reformulation

Authors of NOVA classification do not accept the reformulation of products as a solution (Scrinis & Monteiro, 2017). Product reformulation policies have reduced the availability of nutrients to limit, including reducing energy density of products such as lower-fat milks, low-fat spreads, pre-portioned calorie-controlled meals, and zero-energy beverages (Gibney, 2017; Forde, 2023b). Rather than eliminating UPFs, we should acknowledge their utility and consider that their reformulation, rather than elimination, might have a more meaningful impact on improving the nutritional quality and health on a population level (Derbyshire, 2019; Tobias et al., 2021,).

Misleading information to consumers that all added ingredients, food additives and contaminants are harmful and are only found in UPFs

Many ingredients added to foods resulting in the food being classification as a UPF are derived from raw foods, such as proteins or minerals from milk, or fibres from fruits, vegetables and grains. Even if these ingredients may not appear as '*natural*' to the consumer, their safety as ingredients, including what are considered to be '*novel*' ingredients, is assessed and assured by EFSA (Braesco et al., 2019).

The authors of the NOVA classification define food additives as ingredients that cause poor health. This view is considered unhelpful given that food additives have undergone extensive toxicological assessments to ensure their safety by EFSA and other similar organisations worldwide (Gibney and Forde, 2022). Additives are used when necessary by the food industry for different technological and functional reasons. Many of the additives used in industrially produced foods are also found, sometimes in higher amounts, as natural components in everyday foods, such as lecithin in eggs, citric acid in orange juice and carotene in spinach (Gibney and Forde 2022). Additives can provide the same functionality, and sometimes, even an improved functionality towards health e.g. additives that provide the technical characteristic of salt but with a lesser impact on health. Therefore, the use of additives should not be *a priori* perceived as negative (Visioli et al., 2022).

Studies referring to the NOVA classification also mention processed contaminants such as acrylamide or polycyclic hydrocarbons as a negative effect of UPFs. However, these contaminants can be produced at any level of processing, regardless of whether processing is undertaken at home or by industry. In fact, industrial processes will have a higher degree of control over production of such chemicals (Van Boekel et al, 2010,

Braesco et al., 2019, Visioli et al., 2022). The same is true of contaminants such as pesticide residues, antibiotics, heavy metals, mycotoxins, or packaging migrants. These contaminants are not inherent to UPFs, and the NOVA classification provides no information on their presence in any of the categories of the classification (Braesco et al., 2019).
Conversely, there are examples where food processing has reduced exposure to naturally occurring toxins, such as in cassava root and legumes (Visioli et al., 2022).

Wider effects of focussing policy on UPFs

There is no scientific consensus on how reducing or eliminating UPFs might affect food security, including the cost of food, or the sustainability of the food system, including food waste (Gibney et al., 2017; Jones, 2019; Tobias et al., 2021).

Reducing or eliminating UPFs will likely impact on time, skill, budget and other resources related to food preparation (Estell et al., 2022). Historically, in the 1900s women spent approximately 6 hours per day in food preparation – time which may not be available in the modern context (Jones 2019). Use of processed and UPFs are also helpful, if not necessary, for certain population groups, including the elderly and those with mobility or cognitive limitations (Jones, 2019).

NOVA classification could hamper relevant innovations in sustainable solutions

In addition to the conflicts with nutrition advice, guidelines based on food processing could be misinterpreted as meaning that processing in itself is bad. Such consumer rejection could hamper sustainable innovations that address a more (environmentally and social) sustainable food system (Sadler et al., 2021). The impact of UPFs on greenhouse gas emission is not greater than that of less processed alternatives. Moreover, advancements in food processing technologies can offset any potential threats to sustainability and biodiversity (Capozzi et al., 2021).

References

Ares, G., Vidal, L., Allegue, G., et al. (2016). Consumers' conceptualization of ultra-processed foods. Appetite, 105, 611–617.

Blumfield, M., Starck, C., Keighley, T., et al., (2021). Diet and Economic Modelling to Improve the Quality and Affordability of the Australian Diet for Low and Medium Socioeconomic Households. Int. J. Environ. Res. Public Health, 18, 5771.

Braesco V., Corrieu G., Feillet P., et al., (2019). Aliments dits "ultra-transformés et santé: que faut-il en penser? Publication of the Academie d'Agriculture de France.

Braesco, V., Souchon, I., Sauvant, P., et al., (2022) Ultra-processed foods: how functional is the NOVA system? Eur J Clin Nutr 76:1245-1253

Capozzi, F.; Magkos, F.; Fava, F. et al.,(2021). A Multidisciplinary Perspective of Ultra-Processed Foods and Associated Food Processing Technologies: A View of the Sustainable Road Ahead. Nutrients, 13, 3948.

Chang, K., Gunter, M.J., Rauber, F. et al., (2023) Ultra-processed food consumption, cancer risk and cancer mortality: a large-scale prospective analysis within the UK Biobank. eClinkicalMedicine. 56:101840

Chen, Z., Khandpur, N., Desjardins, C. et al., (2023) Ultra-processed food consumption and risk of type 2 diabetes: three large prospective U.S. cohort studies. Diabetes Care. 46(0):1-10

Cordova, R., Kliemann, N., Huybrechts, I. et al., (2021) Consumption of ultra-processed foods associated with weight gain and obesity in adults: a multi-national cohort study. Clin Nutr. 40: 5079-5088

Derbyshire, E. (2019). Are all 'ultra-processed' foods nutritional demons? A commentary and nutritional profiling analysis. Trends in Food Science & Technology. 94, 98 – 104.

Duan, M.J., Vinke, P.C., Navis, G., et al., (2022). 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. BMC Med 20, 7.

Estell M.L., Barrett E.M., Kissock K.R., et al., (2022). Fortification of grain foods and NOVA: the potential for altered nutrient intakes while avoiding ultra-processed foods. European Journal of Nutrition 61(2):935-945.

Fardet, A., Lakhssassi, S., & Briffaz, A. (2018). Beyond nutrient-based food indices: a data mining approach to search for a quantitative holistic index reflecting the degree of food processing and including physicochemical properties. Food & Function, 9(1), 561–572.

Fazzino, T.L., Courville, A.B., Guo, J. & Hall, K.D. (2023) Ad libitum meal energy intake is positively influenced by energy density, eating rate and hyper-palatable food across four dietary patterns. Nat Food 4(2):144-147

Forde, C.G. (2023a) Processing the evidence to evaluate mechanisms, costs and future solutions. Nutr Bull. 48:157-159

Forde, C.G. (2023b) Beyond ultra-processed: considering the future role of food processing in human health. Proc Nutr Soc. 82: 406-418.

Gibney, M. J., Forde, C. G., Mullally, D., & Gibney, E. R. (2017). Ultra-processed foods in human health: a critical appraisal. The American Journal of Clinical Nutrition.

Gibney, M.J., Forde, C.G. (2022). Nutrition research challenges for processed food and health. Nat Food 3, 104–109.

Hall, K.D., Ayuketah, A. Brychta, R. et al., (2019) Ultra-processed diets cause excess calorie intake and weight gain: an inpatient randomised controlled trial of ad libitum food intake. Cell Metab. 30, 1-11

Hess, J.M., Comeau, M.E., Casperson, S. et al., (2023) Dietary guidelines meet NOVA, developing a menu for a healthy dietary pattern using ultra-processed foods. 153: 2472-2481

Jaime-Lara, R.B., Franks, A.T., Agarwal, K., et al., (2023) No significant salt or sweet taste preference or sensitivity differences following ad libitum consumption of ultra-processed and unprocessed diets: a randomized controlled pilot study. Chem Senses. 48:bjad007.

Jones, J. M. (2019). Food processing: criteria for dietary guidance and public health? The Proceedings of the Nutrition Society, 78(1), 4–18.

Lasschuijt, M., Camps, G., Mars, M., et al., (2023) Speed limits: the effects of industrial food processing and food texture on daily energy intake and eating behaviour in health adults. Eur J Nutr. 62: 2949-2962.

Marino, M., Puppo, F., Del Bo', C., et al., (2021). A Systematic Review of Worldwide Consumption of Ultra-Processed Foods: Findings and Criticisms. Nutrients, 13(8), 2778.

Mertens, E., Colizzi, C., Peñalvo, J.L. (2022) Ultra-processed food consumption in adults across Europe. Eur J Nur. 61:1521-1539

Nordic Nutrition Recommendations (NNR) (2023) https://pub.norden.org/nord2023-003/ultra-processed-foods.html

O'Connor, L. E., Higgins, K.A., Smiljanec, K., et al., (2023) Perspective: a research roadmap about ultra-processed foods and human health for the United States food system: proceedings from in interdisciplinary, multi-stakeholder workshop. Adv Nutr. 14;1255-1269

Petrus, R. R., do Amaral Sobral, P. J., Tadini, C. C., & Gonçalves, C. B. (2021). The NOVA classification system: A critical perspective in food science. Trends in Food Science & Technology, 116, 603–608.

Poti, J. M., Braga, B., & Qin, B. (2017). Ultra-processed Food Intake and Obesity: What Really Matters for Health—Processing or Nutrient Content? Current Obesity Reports, 6(4), 420–431.

Sadler, C. R., Grassby, T., Hart, K., et al., (2021). Processed food classification: Conceptualisation and challenges. Trends in Food Science & Technology, 112, 149–162.

Sadler C.R., Grassby T., Hart K., et al., (2022). "Even We Are Confused": A Thematic Analysis of Professionals' Perceptions of Processed Foods and Challenges for Communication. Frontiers in Nutrition, 9.

Samuthpongtorn, C., Nguyen, L.H., Okereke, O.I. et al., (2023) Consumption of ultraprocessed food and risk of depression. JAMA Network Open. 6(9):e2334770

Scientific Advisory Committee on Nutrition (SACN) (2023) SACN statement on processed foods and health – summary report. https://www.gov.uk/government/publications/sacn-statement-on-processed-foods-and-health/sacn-statement-on-processed-foods-and-health-summary-report#conclusions

Scrinis, G., & Monteiro, C. A. (2017). Ultra-processed foods and the limits of product reformulation. Public Health Nutrition, 21(01), 247–252

Taneri, P.E., Wehrli, F., Roa-Diaz, Z.M. et al., (2022) Association between ultra-processed food intake and all-cause mortality: a systematic review and meta-analysis. Am J Epidemiology. 191(7):1323-1335

Teo P.S., Tso R., van Dam R.M., Forde C.G. (2022a). Taste of Modern Diets: The Impact of Food Processing on Nutrient Sensing and Dietary Energy Intake. The Journal of Nutrition Jan 11, 152(1):200-210.

Teo P.S., Lim, A.J., Goh, A.T. et al., (2022b) Textrure-based differences in eating rate influence energy intake for minimally processed and ultra-processed meals. *Am J Clin Nutr* 116(1):244-254

The British Dietetic Association (BDA). (2021). Position statement on processed food. https://www.bda.uk.com/resource/processed-food.html

Thielecke, F., Lecerf, J-M., Nugent, A. P. (2020). Processing in the food chain: do cereals have to be processed to add value to the human diet?. Nutrition Research Reviews, (), 1–43.

Tobias D.K., & Hall K.D. (2021). Eliminate or reformulate ultra-processed foods? Biological mechanisms matter. Volume 33, Issue 12, 7 December 2021, Pages 2314-2315.

Van Boekel, M., Fogliano, V., Pellegrini, N., et al. (2010). A review on the beneficial aspects of food processing. Molecular nutrition & food research, 54(9), 1215–1247.

van Langeveld A.W.B., Teo, P.S., de Vries J.H.M. et al., Dietary taste patterns by sex and weight status in the Netherlands. Br J Nutr. 119(10):1195-1206.

Vergeer L., Veira P., Bernstein J.T., et al., (2019). The Calorie and Nutrient Density of More- Versus Less-Processed Packaged Food and Beverage Products in the Canadian Food Supply. Nutrients 11(11):2782.

Visioli, F., Marangoni, F., Fogliano, V., et al., (2022) The ultra-processed food hypothesis: a product processed well beyond the basic ingredients in the package. Nutr Res Rev. 36(2):340-350

Wang, Z, Wang Y, Shand, W., et al., (2023) Reporting quality and risk of bias of systematic reviews of ultra-processed foods: a methodological study. Eur J Clin Nutr online ahead of print - doi: 10.1038/s41430-023-01383-8

Zhang, Y. & Giovannucci, E.L. (2023) Ultra-processed foods and health: a comprehensive review. Crit Rev Food Sci Health. 63(31): 10836-10848