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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 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.

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 and meta-analyses are low quality, subject to high risk of bias and flawed reporting quality, with most evidence rated low to very low 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 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). Although initially developed for studying links between food intake and health (epidemiology), the classifications have subsequently been used to inform dietary guidelines (Sadler et al., 2021). 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 this 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. There is no agreement as to what constitutes a processed food or different degrees of processing, including to what extent they should only reflect technical processes and/or include formulation/ingredients. From a food science and technology perspective, without evidence for a correlation between the extent of processing and a products nutritional value, these aspects should remain distinct. 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).

New dietary intake tools have started to be developed in order to estimate intake according to classifications such as NOVA (Neri et al., 2024),t However, most classification schemes post-date 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). Differences in methods to estimate intake can have a major effect on the estimated risk of adverse health outcomes (Vitale et al., 2024). 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).

The UPF concept may also be incorrectly presented in the media, which is an important avenue for nutrition communication (Russell et al., 2024).

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) and from inaccurate explanations and definitions of the UPF concept in the media (Russell et al., 2024). Consumer confusion over UPFs, including what they are, their health impacts and whether to consume them, has been highlighted in a pan-European study (EIT Food Consumer Observatory, 2024).

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

As highlighted by a number of recent studies, results of observational studies are likely 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), which if inadequately or not controlled for could affect associations. 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).
- Researchers have used statistical methods to illustrate that residual and unmeasured confounding, even by factors which are not strongly associated with the exposure or outcome, could hypothetically explain the prospective association between UPF consumption and health outcomes (Robinson and Jones, 2024).
- In a recent large and long duration cohort study examining the association between UPF consumption and mortality, it was shown that that the method of adjusting for smoking (using pack years) in addition to adjusting for overall diet quality had major effects on reducing associations. The association was also affected by whether alcohol (increased risk) or wholegrains (reduced risk) were included as UPFs (Fang et al., 2024).
- A finding that consumption of UPFs is associated with increased risk of accidental death, such as falls, transport accidents and accidental drowning, for which there is no plausible biological mechanistic pathway, indicates caution is required before considering associations between UPFs and adverse health outcomes reflects a causal relationship (Morales-Bernstein et al., 2024).

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, with increased UPF intake correlated with an increase in free sugars, total fats, and saturated fats, as well as a decrease in fibre, protein and many micronutrients (Martini et al., 2021). A high 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). Results from a large long-term cohort study which estimated UPF intake over time provide support for the importance of more rigorous control for confounders (Fang et al., 2024). In this study, dietary quality was considered to have a greater influence on health outcomes with the additional effect of food processing likely to be limited.

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 and meta-analyses are low quality, subject to high risk of bias and flawed reporting quality, with most evidence rated low to very low quality.

Systematic reviews investigating associations between UPF consumption and health outcomes have been rated as ‘low’ and ‘very low’ quality, with a high risk of bias and flawed reporting quality,requiring significant improvement in order to more reliably inform health policies (Barbaresco et al., 2024; Wang et al., 2023).

The quality of evidence within systematic reviews and meta-analyses has consistently been mostly rated as ‘low’ or ‘very low’ (Barbaresko et al., 2024; Lane et al., 2024; Lv et al., 2024; Vitale et al., 2024).

Taken together, the poor quality of studies and low certainty in the evidence indicates that results should be interpreted and used cautiously.

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

Many 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 (Chen et al., Cordova et al., 2023; Duan et al., 2022; Fang et al., 2024; Samuthpongtorn et al., 2023; Taneri et al., 2022). Adjusting for or excluding these sub-categories may render associations between UPF consumption and health outcomes as not significant (Visioli et al., 2024; Freisling et al., 2024) This

would suggest that the overall concept for an UPF-based classification is flawed, not useful and misleading.

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 controlled or ad libitum feeding studies are warranted to inform on specific properties of processed foods that may result in adverse health outcomes (Forde, 2023b; Government Office for Science, 2024).

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; Government Office for Science, 2024). Mechanisms may be divided into those which drive overconsumption and those which may cause direct harm to biological systems (Government Office for Science, 2024). 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 the energy density and salt content of products and increasing the population intake of micronutrients of concern (Gibney, 2017; Forde, 2023b). Rather than eliminating all UPFs, we should acknowledge the utility of processed foods and, based on science, 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 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).

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