POLICY LAB REPORT

Low-agency population interventions to reduce meat consumption

Global Food Security

Sustainable, healthy food for all

Contents

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Executive summary

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The global demand for meat products is growing. Despite the increasing popularity of plant-based diets, their overall prevalence remains low and meat consumption is rising, with negative consequences for both human and planetary health. This report provides an assessment of the evidence for the effectiveness of low-agency population interventions (LAPIs; i.e. interventions that requires little or no effort from the targeted population) at reducing meat selection, purchase, or consumption. We consider the effectiveness of these interventions when applied to red and processed meat, as well as other foods, with the goal of applying the insights to meat.

An umbrella review of 44 systematic reviews was conducted to synthesise all the available evidence, followed by a critical assessment to discuss the wider insights gained and the implications for policy and practice.

Recommendations and lessons learned from the current review are primarily based on interventions focusing on a range of foods, as the evidence on interventions targeting meat specifically was limited. Overall, the evidence summarised in this report suggests that a number of these interventions could be implemented to positively restructure food environments and reduce meat consumption.

Key findings (summarised in Figure 1)

- Reducing portion sizes of meat products can reduce the selection, purchase, and/or consumption of meat.
- Pricing strategies such as taxes, subsidies, and discounts, as well as changing the relative availability of products at the point of sale, can change the selection, purchase, and/or consumption of other foods.
- There was limited or mixed research on the effectiveness of changing the presentation/ position of meat products or reformulating the ingredients in food containing meat.

Recommendations

- These interventions are likely to have greater impact if they are implemented simultaneously (i.e. multi-component interventions) as they can work synergistically to build healthier food environments and change social norms.
- Interventions should be implemented in multiple locations where food is purchased to avoid displaced or compensatory meat consumption.
- Low-agency population interventions are likely to have high public acceptability because they maintain freedom of choice.

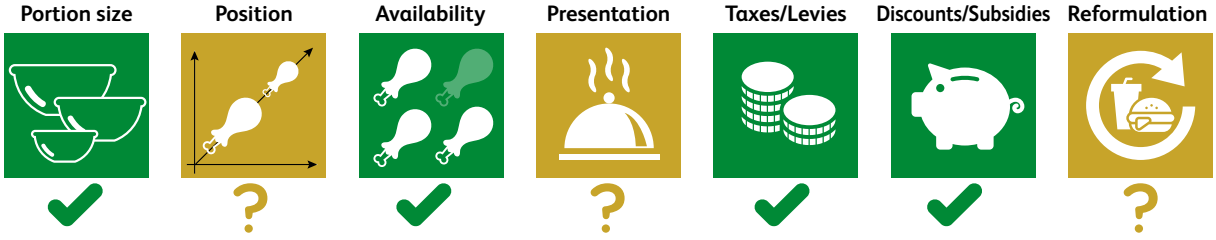

Figure 1. Summary of the review's evidence on the effectiveness of low-agency interventions in reducing selection, purchase, or consumption of food. Tick: Intervention can be effective; question mark: effectiveness of the intervention is unclear.

The problem with high-meat diets

Global demand for meat is projected to grow by 88% from 2010 to 2050[1], however the overconsumption and overproduction of meat is already impacting human and planetary health. Efforts to reduce these impacts include modifying the types (e.g. ruminant meat vs poultry) and amount of meat produced and consumed. Importantly, the goal here is not to eliminate meat from our diets, but instead to reduce it to a level that minimises the impact on health and the environment.

Environmental impacts

The intensive use of fertilisers and pesticides to grow grain for feeding livestock, the large use of natural resources such as land and water, and production-related emissions, all contribute to the negative impact of meat production on the environment. Livestock production uses about 80 % of global agricultural land[2], the majority of which could otherwise be used to grow plants for human consumption or for rewilding. Thus, repurposing this land could have numerous environmental benefits, including reducing carbon in the atmosphere and improving biodiversity. The recent Intergovernmental Panel on Climate Change pointed to the need to reduce meat consumption to help mitigate the effects of climate change[3].

Health impacts

Meat contains numerous essential nutrients and is a key component of many people's diets, however the overconsumption of red and processed meat increases the risk of mortality and morbidity (Figure 2). Evidence from population studies suggests that high meat consumption, particularly red and processed meat, is associated with increased risk of chronic diseases such as diabetes[4], cardiovascular disease[5] and certain cancers[6-8]. Various governments (e.g. Norway, UK, Italy, and Brazil) and the wider health community have already established recommendations to reduce the consumption of red and processed meat.

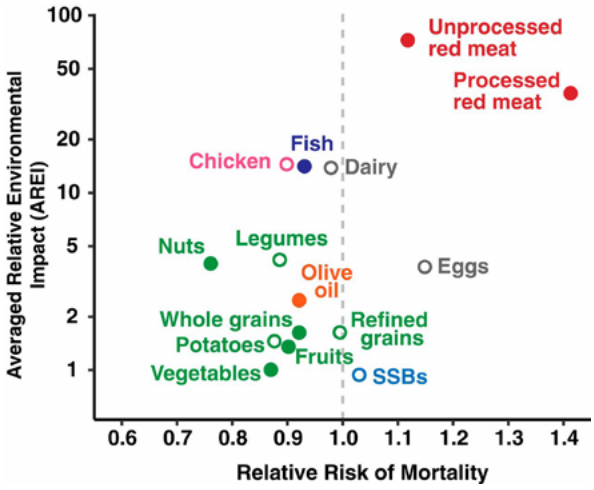

Figure 2. Food groups and their impact on health and environment. The Average Relative Environmental Impact (y-axis) indicates the average impact of a food group across five environmental outcomes relative to the impact of producing a serving of vegetables. Values of relative risk of mortality (x-axis) above 1 indicate that consuming an additional daily serving of a food group is associated with increased mortality risk, whereas values below 1 indicate that consumption is associated with lowered mortality risk. Food groups with a significant change in risk of mortality are denoted by solid circles. SSBs = sugar-sweetened beverages. Source: Clark et al., 2019, published by PNAS. Licensed under CC BY 4.0. DOI: 10.1073/pnas.1906908116 [48].

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Shifting the UK diet

Reducing meat consumption will be a significant challenge. In the UK, about 73% of consumers consider themselves meat eaters, while another 14% consider themselves flexitarians (i.e. mainly vegetarian diet, allowing for occasional meat dishes)[9]. Whilst vegetarian diets and vegan diets may be increasing in popularity, the overall prevalence is still relatively low (3% and 1% of the UK total population are vegetarians and vegans, respectively[9]) and the trend has not yet halted the growing global demand and the (subsequent) production of meat[10].

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The intention-behaviour gap

Studies have shown that some meat-eating consumers are willing to reduce their meat consumption[11], yet individuals' attempts to change their own consumption are often ineffective due to the strong influence of food environments on consumption[12]. This includes the widespread availability, large portion sizes, heavy marketing, and the low cost of less healthy foods. Information-based strategies to change behaviour tend to be the most popular[13], yet simply educating individuals about the risks of certain behaviours is insufficient to change behaviour over long periods of time[14]. It is therefore unlikely that the sole provision of information about the health and environmental risks associated with meat consumption will reduce its consumption.

Low-agency population interventions

An alternative approach involves low-agency population interventions (i.e. interventions require little or no engagement from individuals). Here, food environments are designed to encourage individuals to make healthier and more sustainable food choices without limiting their freedom of choice. In these environments, extreme levels of self-control would not be required to avoid the overconsumption of meat. Instead, changes to the environment would guide individuals toward consuming less meat with minimal conscious engagement and may therefore be more effective and equitable than other strategies[15]. This approach can also change norms; being provided with smaller portion sizes can lead to individuals choosing smaller portions in other settings[16].

Low-agency population interventions include taxes on less healthy foods or nudging strategies like changing the availability and placement of food products, reformulating food products and changing portion sizes. These approaches have been demonstrated to reduce individuals' excess consumption of many types of food (e.g. chocolate, hot meals, crisps) and therefore have potential for reducing meat consumption[17-19].

A food systems approach

Incorporating systems thinking into the design and evaluation of low-agency interventions may also be required to shift the UK diet. Systems thinking can be applied to anticipate, capture, and better understand the complexity of interacting exposures (e.g. demand for a specific food such as red meat) and responses (e.g. expansion of cattle farming) in the context of the wider food system[20]. Recognising the interrelated and interdependent nature of the food system helps to navigate its complexity and identify key areas which can be targeted effectively using low-agency interventions.

Could LAPIs reduce meat consumption?

This section provides an overview of the evidence for the potential of low-agency population interventions (LAPIs) to reduce meat consumption. Systematic reviews investigating the effectiveness of different LAPIs to change the selection, purchase or consumption of various types of foods were included in this umbrella review (see Appendix).

Portion size

Three studies (one set in a restaurant, the other two set in labs) have demonstrated that interventions that reduce the portion size of meat, also reduce the consumption of meat products[21]. Systematic reviews that investigated reducing the portions of foods in general provide similar results: reducing portion sizes leads to reductions in the amount of food that is consumed[22,23]. The effectiveness of reducing portion sizes for portions that are already small is less certain than the evidence of reducing the size of large portions. Individuals also tend to select larger portions of food when given the option, suggesting that even if they do not consume the whole portion they are still likely to choose it. This creates the demand for more food to be produced, potentially increasing food waste.

Positioning

There is mixed evidence that repositioning meat to make it less prominent compared to other foods reduces the selection or purchasing of meat[21]. Repositioning meat and other food products has been tested in multiple settings (e.g. changing the order in an online meal booking system; removing meat options from a restaurant menu and repositioning to a board 3.5 metres away; moving the target food to the last item in a breakfast buffet) and these different methods of intervening may account for the mixed results[21,24]. While there is insufficient evidence to determine the most effective method of repositioning food options, moving meat options from menus to a specials board in restaurants may be effective at reducing demand. Further research is needed to reduce the uncertainties.

Availability

There is limited evidence evaluating whether reducing the number or proportion of meat options decreases selection, purchase, or consumption. However, increasing the availability of meat-free options has been shown to reduce the consumption of red, processed, and white meat in several studies[21]. Some of these interventions were accompanied by additional components (e.g. the provision of information about the health benefits of being vegetarian), which makes it unclear how effective it would be to only increase the availability of meat-free options. The majority of research on availability interventions has instead focused on other foods (such as fruit and vegetables) and how providing healthier options can increase demand for these options and reduce demand for less healthy or higher energy options[24-29]. Evidence from other reviews indicates that adding or removing products is an effective strategy. For example, increasing the availability of healthier foods leads to increases in the consumption of those foods in a variety of settings such as mobile food carts, cafeterias, and vending machines[28,30,31].

Presentation

Changing the sensory properties of meat is reported to be effective at reducing meat selection. However, in this review, studies only evaluated participants' preferences without objective purchase or consumption data[21]. Two different approaches were tested, the first involving changing a visual image that accompanies roast pork: one including the head of the pig while another did not include the head. Including the head of the pig led to participants preferring a meat-free alternative. The second approach was pre-testing which meat-free options sounded the most and least desirable from a larger list. When presented with meat options and the desirable meat-free options, participants were less likely to select a meat

option. Furthermore, improving the presentation of vegetables, salads, and healthy desserts can increase consumption of these items[31,32]. This suggests that improving the presentation of non-meat options may lead to a reduction in meat selection.

Taxes and levies

There were no systematic reviews that focused on the use of pricing strategies to change meat consumption. However, pricing strategies such as taxation yielded promising results with other food groups. Taxes on energy-dense foods including meat (e.g. minced beef) were proposed as an effective measure that could significantly reduce consumption and was recommended as part of a comprehensive strategy to prevent obesity[18,19,33,34]. Taxes on saturated fat (contained in meat products) may, however, result in unintended compensatory purchasing behaviour (i.e. increased consumption of foods high in sodium, sugar and calories). This could reduce the potential health impacts of food taxes, although they do achieve the primary aim of reducing saturated fat intake[19]. Price increases on other less healthy foods were mostly found to reduce sales or consumption of the targeted product, and in all cases this was linked with increased sales or consumption of fruits or vegetables[35]. It is unclear what the minimum increase in price should be to result in a meaningful reduction in meat purchases. However, research on other foods suggests that a tax rate of 20 % has positive impacts[36] whereas further research indicates that a 40 % increase in price could lead to a 6 % decrease in the consumption of high-salt foods[37]. While there may be limited evidence for pricing strategies for meat, the initial evidence from other food groups suggests that increasing the price via taxation is an effective strategy, and therefore should be trialled on meat to confirm its effectiveness.

Discounts and subsidies

Another fiscal intervention involves reducing the prices of meat-alternatives via discounts or subsidies, with a view to reducing the purchase and consumption of meat. Most studies report that lowering the price of healthier foods increases purchasing and consumption of these foods (e.g. fruits and vegetables, grains) or decreases purchasing and consumption of less healthy foods[35]. Pairing subsidies on healthy foods with taxation on less healthy foods was recommended to be the most effective strategy to improve healthy food consumption and diet, particularly where taxes were larger[34]. Combining food taxes with subsidies would also enable consumers to switch to more healthy products without incurring additional costs[18]. Other findings on subsidies were mixed. Subsidies on healthy foods (e.g. fruits and vegetables) could result in unintended compensatory purchasing. One study indicated that a fruit and vegetable subsidy may have unintended compensatory effects including a decrease in fish consumption, and a fibre subsidy could also decrease fish and increase sugar consumption[19]. This evidence suggests that reducing the prices of meat substitutes may increase the consumption or purchasing of the targeted foods, however it is unclear whether this strategy alone (without a tax on meat products) would lead to reduced meat purchasing.

Food reformulation

Reformulation of meals may have the potential to reduce meat intake via similar routes to reducing portion size. However, no reviews have yet examined this intervention within the context of meat. For other foods, Sisnowski et al. (2017) report a case in Washington State where, following a new menu labelling regulation, chain restaurants reformulated their foods to have lower calories[33]. However, the interventions failed to achieve a significant effect on consumption. Further research is needed before any reliable conclusions can be drawn.

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Implications for policy and practice

This critical assessment details what the outcomes of the umbrella review mean for policy and practice. Three implications are discussed within the wider context of reducing meat consumption, and how these findings may be applicable within the general population.

The promise of multi-component interventions

Interventions targeting multiple aspects of the food environment at different levels (multi-component interventions) appear to mutually reinforce each other and are most likely to change dietary behaviours[31,37,38]. Dietary behaviours are complex and shaped by close physical surroundings, as well as the wider environment (including cultural, economic and political influences). Whilst multi-component interventions are more effective in changing the selection, purchase or consumption of foods, longer-term impacts remain unclear. Further reviews looking at the effectiveness of multi-component interventions are needed.

Noticeably, multi-component interventions commonly include an educational component. Whilst education is a common approach to changing behaviour, there is limited evidence of the effectiveness of an approach entirely reliant on education, especially in the long term. Education needs to be accompanied by interactions at multiple levels of the food environment in order to achieve sufficient and sustainable influence on dietary choices or intake. This also highlights that multi-component interventions need to function in synergy to achieve their intended outcomes.

Dietary behaviours may also be improved by increasing the availability of and access to healthier choices – not just independently, but together. This may increase familiarity with new or disliked foods, positively shape preferences, and could eventually drive changes in social norms and intake. Other factors might also play a simultaneous role, for example: cultural norms are key determinants in dietary behaviours and could be used to foster healthy behaviour change. This added complexity of repeated exposure could also drive change through consumer choices, which over time could create new demands and modify preferences and social norms. The commercial food system can then react and adapt to meet changes in consumer demands and reinforce these dietary changes.

With this vast complexity it is clear that interventions or policies that modify multiple different aspects of this system have a greater potential for success. Whilst the existing literature suggests that multi-component interventions have the potential to influence dietary choice and intake, there is a noticeable dearth of such studies specifically targeting meat-related outcomes.

The risk of focusing on isolated settings

Low-agency interventions that focus solely on isolated settings may displace individuals' consumption rather than reducing it.

Several systematic reviews focused on interventions within specific isolated settings, such as the workplace[21,25,39], schools[38,40], restaurants[21,41], retail grocery stores[26], residential care[32,42] and hospitals[32,42]. None of the settings targeted suppliers, highlighting a clear gap in the implementation of low-agency interventions further up the supply chain. By

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focusing on isolated settings, the outcomes of the interventions are limited to the setting examined, e.g. the sales of fruit and vegetables from a worksite cafeteria[39]. Hence, it was not considered whether individuals altered other aspects of their consumption throughout the day.

A few studies did explore overall consumption throughout the day[40,43]. The results suggest that individuals are likely to have engaged with compensatory eating behaviours later in the day (e.g. "I was good at lunch when I ate the apple, so now I deserve a sausage roll"), or even within a single eating occasion ("I chose the vegetable soup as a starter so now I deserve the steak as a main dish"), as a response to a nutritional intervention. This indicates the need to intervene in multiple settings, and multiple parts of the food system, at the same time rather than focusing on isolated settings.

Pairing different interventions together across different settings to address displacement of meat consumption should be further explored to guide the design of future interventions. Most systematic reviews included in our report acknowledged that the effectiveness of intervention strategies may be limited to the setting in which they were implemented (e.g. effective nudge strategies in schools might be different from effective strategies in the workplace). They also highlighted the importance of adapting each intervention strategy to the corresponding environment and target group.

Focusing on isolated settings is also poorly aligned with the idea of a complex food system. Individuals interact with multiple settings on a daily basis, hence nudging strategies would need to be implemented synergistically across these settings to reduce meat consumption whilst avoiding unintended consequences. This highlights the need for a food systems approach when implementing food system interventions.

Public acceptability of interventions and policies

The acceptability of low-agency interventions in the population could be difficult to ascertain and may not include direct investigations of acceptability, as these interventions usually target non-conscious processes in decision making. Public acceptability of policies is also often complicated by current politics and ideology. Existing evidence has shown higher levels of acceptability for 'soft', high-agency interventions such as educational approaches[13,44]. Low-agency strategies that maintain freedom of choice such as those described above are likely to be more widely accepted by the public than high-agency interventions that limit freedom of choice, e.g. by placing restrictions on fast-food outlets.

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It is also important to understand acceptability from the perspectives of government and industry (producers, manufacturers, processors, supermarkets, etc.), as uptake is a key challenge in the process of re-shaping food systems. Industry stakeholders are more likely to use and endorse low-cost techniques or those that do not compromise profits. However, current strategies usually focus on public acceptability without assessing acceptability from different stakeholders and at different levels of the system, i.e. from food production to food consumption.

Conclusions

This umbrella review and critical assessment suggests several promising routes for reducing the selection, purchasing, and consumption of meat. Research on both meat and non-meat foods suggests that several interventions are effective. Reducing the portion size of meals appears to be effective at reducing consumption. Increasing the number of healthier foods and decreasing the number of less healthy foods can increase selection of the healthier foods (i.e. Availability interventions). Increasing the price of less healthy foods and decreasing the price of healthier foods appears to be effective in changing purchasing, particularly when implemented together. Further approaches such as reducing the prominence of meat in restaurants and improving the presentation of meat alternatives also show promising results.

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Whilst there has been less research conducted on the effectiveness of some of these interventions (i.e., taxation, discounts) at changing the selection, purchasing, or consumption of meat specifically, the evidence from testing these interventions on other foods suggests these interventions are effective and could be applied to meat. Overall, the evidence summarised in this report suggests that restructuring the food environment through multiple approaches can create environments that encourage individuals to choose foods with an overall reduced impact on both the environment and health, without removing freedom of choice. A key point is that in isolation these interventions may have small effects, yet when combined with other interventions, there is a potential for greater impact at the population level.

A majority of the UK public already supports many of these interventions when applied to other less healthy food and drinks[13]. Considering that the interventions described in this report allow for meaningful reductions in meat demand without removing freedom of choice, they may have the benefit of being both effective and acceptable to the public. Unlike the public, stakeholders working to produce and sell meat products throughout the food system are likely to oppose such interventions[45]. If interventions successfully reduce the demand for meat, then these stakeholders should receive support to transition to sustainable business models that support human and planetary health.

Research and activities that actively elicit input from stakeholders at all stages of the food system could prove valuable in forming a joint sense of responsibility for enacting food system change. Structural challenges, such as food supply chains transcending national and institutional boundaries, or food security programs adopting a production-centric approach, are largely considered too complex and far removed from an individual stakeholder's control. Only by incorporating the different sustainability needs and wants of all stakeholders (from farmers to suppliers, supermarkets, and consumers) will mutually agreeable sustainability objectives become achievable[46].

Whilst this report provides evidence on a range of interventions and policy options available to address the overconsumption of meat, the recommendations and lessons learned from the systematic reviews come from intervention studies that have focused on food generally, with only a few specifically focused on meat. Furthermore, it is less clear what action would be effective further up the supply chain, as the umbrella review did not yield any reviews of interventions at that level. The evidence base for interventions aiming to reduce meat demand is less mature than needed, yet the urgency with which we need to address the combined challenges of improving both health and environmental sustainability will mean moving forward under uncertainties. While further research is needed to reduce these uncertainties, the evidence summarised in this report should provide enough confidence for policy makers to take judicious action now.

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Glossary

Technical terms

Choice architecture	The way food choices are presented to consumers. This can be altered to nudge behaviour in a particular direction.
Critical synthesis	A critical assessment of evidence that goes beyond description to include a degree of analysis and conceptual innovation.
Low-agency population intervention (LAPI)	An intervention that requires little or no effort from the targeted population to be beneficial.
Systematic review	A replicable method of searching for all scientific research on a specific topic.
Umbrella review	A systematic review of systematic reviews.

Interventions

Availability	Adding or removing the number of products to increase, decrease, or alter their range, variety or number.
Discounts	Reducing the usual price of the targeted product.
Portion size	Alter the portion size (typically reducing) of food or drink products.
Position	Altering the position, proximity, or accessibility of products.
Presentation	Altering the visual, tactile, auditory, or olfactory properties of products.
Subsidies	Providing money to businesses to lower the price of targeted products.
Taxation	Adding a tax or levy on a product or one of its ingredients with the aim of increasing the price of the product.

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Appendix

Our approach

This report provides a comprehensive overview of the effectiveness of low-agency population interventions to reduce the selection, purchase and/or consumption of meat products. The results presented are a combination of two different approaches to synthesising the existing evidence from systematic reviews. First, an umbrella review was conducted to synthesise existing information from systematic reviews of low-agency population interventions aiming to reduce the selection, purchase and consumption of meat. Second, a critical assessment of that evidence was conducted to draw a range of considerations that support the interpretation of the systematic reviews. Twelve databases from a wide range of disciplines were searched for systematic reviews of interventions in any settings that targeted meat products but also other types of food, in order to accumulate more evidence and develop insights that could also be applied to meat (see 'The Umbrella Review Method').

Eligible interventions were those that required little or no engagement from individuals, including: environment modifications to cue behaviour change, modified or amended choice architecture (proximity, availability, shape of product), changing the default available products (i.e. changing the status quo products), reformulated food products (i.e. reduced meat content), changed portion sizes, or altered food prices using levies, subsidies or discounts. Once databases were searched, relevant systematic reviews were screened for eligibility. Eligible papers were then graded for quality using the appraisal tool AMSTAR[47] and all relevant information to the review was extracted.

The search yielded 44 systematic reviews that were judged eligible. These systematic reviews investigated the effectiveness of one or more eligible interventions at changing the selection, purchase, or consumption of food. Meat consumption-related outcomes were specifically investigated in one review[21], with seven further reviews including interventions that reported meat intake (as part of a composite meal) as an outcome.

StockSnap/Pixabay. Jeff Siepman/Unsplash

The Umbrella review method

Eligibility criteria

Studies were included if they were systematic reviews, evaluated the effectiveness of low-agency population interventions in "real world" or laboratory settings, and measured the selection, purchase, or consumption of any food.

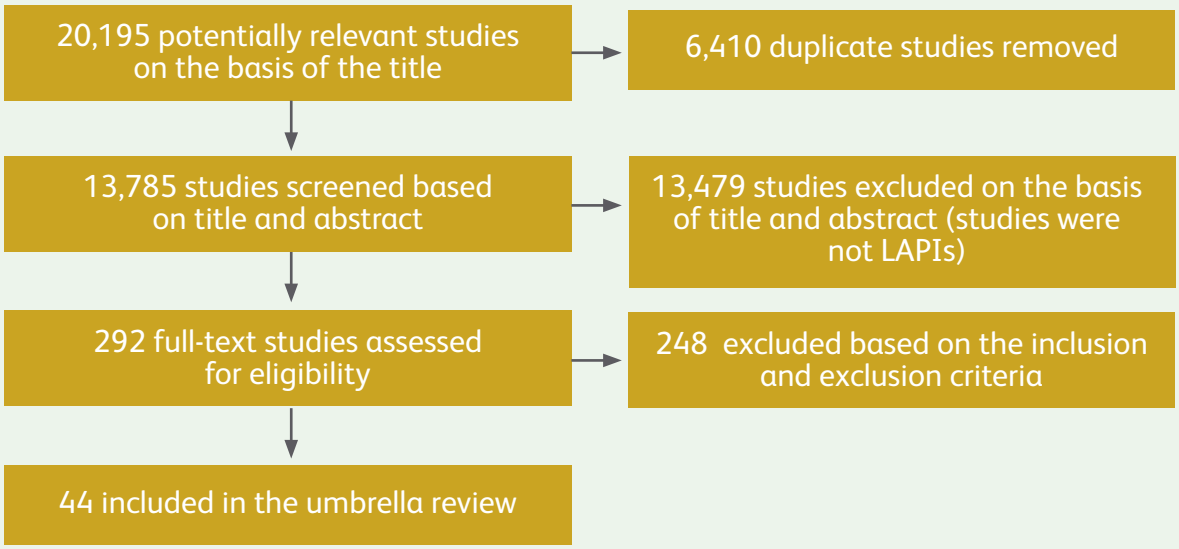
Databases searched

ABI/INFORM, AGRICOLA, ASSIA, Campbell Library, Cochrane Library, EconLit, MEDLINE, OpenGrey, PsycINFO, PubAg, Scopus, and Web of Science. Databases were searched up to October 2018.

Search terms

(accessib* **OR** availab* **OR** "choice architecture" **OR** influence **OR** intervention **OR** levies **OR** levy **OR** "low agency" **OR** "low agentic" **OR** "low engagement" **OR** nudg* **OR** order* **OR** placement **OR** portion size* **OR** position* **OR** price* **OR** proximity **OR** reposition* **OR** reformulat* **OR** stealth **OR** tax* **OR** pric* **OR** "physical micro-environments" **OR** Procur* **OR** Produc*) AND (consumption **OR** purchas* **OR** reduction **OR** selection **OR** preference* **OR** choice* **OR** intake **OR** demand **OR** sales **OR** eat* **OR** intention* **OR** buy*) AND (beef **OR** diet* **OR** meal* **OR** food* **OR** lamb **OR** meat* **OR** pork **OR** sausage* **OR** steak* **OR** mince **OR** burger* **OR** veal **OR** bacon **OR** ham) AND (systematic review search terms from SIGN https://www.sign.ac.uk/search-filters.html)

Screening and selection of eligible studies



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This report does not necessarily reflect the policy positions of the Global Food Security programme's individual partners.

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