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Improving nutritional health through front-of-pack warning labels on ultra-processed foods

Key highlights

Reformulation post-FoPWL introduction reduces all nutrients of concern

Evidence across South and Central America demonstrates reductions, particularly in sugar (Cadena, Gallo and Soto, 2025; Mamani-Urruti, Durán-Galdo and Bustamante-López, 2025; Scarpelli et al., 2020).

Octagonal warning labels are the most impactful FoPWLs

OWLs perform 3-4x better than control groups for consumers identifying product healthiness and purchasing the healthiest option (da Silva Gomes et al., 2025a, 2025b).

Marketing techniques and health claims negate FoPWL impact

These techniques can counteract the health messaging of FoPWLs (Cadena, Ares and Gantiva, 2026) and are used on unhealthy foods to negate FoPWL impact (Saavedra-Garcia et al., 2022).

There is no evidence of FoPWLs causing economic harm

Jobs and wages were not impacted by the implementation of FoPWL policies in Chile or Peru (Díaz et al., 2023; Paraje et al., 2021).

Public awareness campaigns needed alongside FoPWLs

Need to overcome people's habits and regular purchase behaviour, requiring more than just FoPWLs (de Alcantara et al., 2026; Machín et al., 2023; Sagaceta-Mejía et al., 2025).

Labelling by nutrients rather than degree of processing has more impact

Adding an "ultra-processed" warning label in Brazil had no significant impact on purchasing behaviour (D'Angelo Campos et al., 2024).

Introduction

This REA assesses the latest evidence on the impact of front of pack warning labels (FoPWLs) on the consumption of ultra-processed food (UPF) in South and Central America considering health and economic impacts/outcomes.

Consumption of UPFs (also known as ultra-processed products or UPPs) is an increasingly large global health issue (Monteiro et al., 2025), and a topic of particular concern in South America where consumption of UPFs is growing exponentially (Matos, Adams and Sabaté, 2021). In 2022, 10% of premature deaths in Brazilian adults were attributed to consumption of UPFs (D'Angelo Campos et al., 2024); in 2020 in Chile, one third of the population were obese (Sambra et al., 2020) and 28.6% of energy intake came from UPFs (Scarpelli et al., 2020); between 2009 and 2019 Peru had the highest increase in UPF consumption in South America – in the same period obesity among 5-9 year old children rose from 19.4% to 37.4% (Saavedra-Garcia et al., 2023); in the last decade Mexico has seen sales of UPFs rise 29.9% (Sagaceta-Mejía et al., 2025). While it is difficult to draw causal links when looking at a network as complex as the food system, *The Lancet* recently published a series of papers examining the issue, including meta-analyses showing an association between consumption of UPFs and a wide range of non-communicable diseases (NCDs) and all-cause mortality (Monteiro et al., 2025).

One intervention that has been used across Latin American countries in recent years is nutritional warning labelling – usually taking the form of black octagonal labels (de Alcantara et al., 2026). There are a variety of different nutritional label designs around the world – including Nutri-Score, traffic-light labelling (TFL) and guideline daily amounts (GDA), and there is ongoing research into the relative impact of each design (da Silva Gomes et al., 2025b). The use of these different label designs around the world makes conducting comparative studies between nations difficult; South and Central America was selected as the target population for this REA due to the relative degree of FoPWL design similarity that exists in the region (Munguía et al. 2021) (Figure 1), making it possible to assess their impact on UPF consumption for these populations.

Figure 1: Most South and Central American countries use OWLs for nutrients of concern, with Brazil using a magnifying glass design (Munguía et al. 2021)

The evidence

The evidence used for this REA came from 20 peer-reviewed journals, including quantitative experimental studies (n=9), quantitative observational studies (n=7), qualitative studies (n=2) and economic studies (n=2). To give insights to FoPWL policies across South and Central America, studies were selected that covered a variety of countries: Peru (n=5), Chile (n=4), Brazil (n=3), Colombia (n=3), Mexico (n=2), Uruguay (n=1) and Costa Rica (n=1).

All the studies were directly relevant to FoPWLs, but while the target of FoPWLs are usually UPFs (Diez-Canseco et al., 2024; Saavedra-Garcia et al., 2023) the studies didn't directly examine the consumption of foods by their degree of processing. The majority of the studies examined consumer health awareness and changes in behaviour resulting from FoPWLs (n=9), with other evidential themes being product reformulation (n=6), the diluting effect of marketing techniques and health claims (n=3) and consequences for jobs and wages (n=2).

Health-related evidence

Product reformulation

In the evidence from these studies, FoPWLs' impact on product reformulation (altering the composition of ingredients to comply with new legislation) was measured in Chile (Sambra et al., 2020; Scarpelli et al., 2020), Peru (Mamani-Urruti, Durán-Galdo and Bustamante-López, 2025; Saavedra-Garcia et al., 2023), Colombia (Cadena, Gallo and Soto, 2025), and Mexico (Salgado et al., 2025). All these countries have implemented black octagonal warning labels (OWLs) in the past 15 years.

There was consistent evidence that significant reformulation took place after the introduction of FoPWLs. The nutrients that saw the largest reductions in the periods studied were sugar, saturated fat and sodium (the change in these nutrients across countries can be seen in Table 1). In addition to these figures, the proportion of breads and cereals requiring an excess sodium warning label fell by 63.1% in Mexico (Salgado et al., 2025).

Country	Change in sugar	Change in sodium	Change in saturated fat	References
Chile	-15%	-9.2%	-1.5%	(Scarpelli et al., 2020)
Peru	-36.7%	-3.4%	-9.2%	(Mamani-Urruti, Durán-Galdo and

				Bustamante-López, 2025)
Colombia	-46% (Drinks) -26% (Food)	+89% (Drinks)	No significant change	(Cadena, Gallo and Soto, 2025)

Table 1: Reduction in nutrients of concern by country

Reformulation led to nutrients of concern reducing in products across all countries, particularly sugar, with the 89% *increase* in sodium in Colombian drinks (Cadena, Gallo and Soto, 2025) being a notable outlier. In relation to Mexico Salgado et al. (2025) describe how this reformulation can have a positive impact on health, as even people who do not use FoPWLs will be consuming fewer harmful nutrients.

All the studies related to reformulation scored highly in relevance to the subject of the REA, as reformulation is a recognised industry tactic to try and avoid FoPWLs and other interventions that could impact sales (Díaz et al., 2023). They also scored similarly for robustness (Appendix 1), as they were all observational and their methodology involved comparing the declared nutrients on packaging of popular products pre- and post-implementation of FoPWL policies (except Sambra et al. who took one sample looking specifically at non-caloric sweeteners (NCS) in Chile).

Looking at implications for UPFs, it was recognised that the impressive 46% reduction in sugar found in beverages from in Colombia from 2015-2024 was likely due to increasing use of NCS (Cadena, Gallo and Soto, 2025). There was also a noted increase in NCS content of beverages in Peru – from being found in 34.5% of beverages in March 2019 to 62.1% in May 2021 (Saavedra-Garcia et al., 2023). After the implementation of FoPWLs in Chile, 55.5% of all products analysed contained at least one NCS – with this figure being over 90% in many products aimed at children (Sambra et al., 2020). This is an example of how reformulation could end up making products healthier, but more ultra-processed (Salgado et al., 2025).

Salgado et al.'s study stands out as having seen a reduction in NCS in salty snacks from 12.4% to 0%, which is hypothesised as being because Mexico (unlike Chile and Peru) included a FoPWL specifically to indicate the presence of NCS in addition to the OWLs (Salgado et al., 2025). Although it is notable that the same study showed no meaningful reduction in caffeine content in sweetened beverages, despite a FoPWL also being present for caffeine (Salgado et al., 2025). The acceleration of NCS use in other countries in the region, notably Chile because it has the highest presence of sweeteners in its food supply, could be a cause of concern for health especially as it's very plausible children could be exceeding their recommended daily intake of NCS (Sambra et al., 2020).

Consumer health awareness

FoPWLs belong on the second rung of the Nuffield Intervention Latter (Figure 2): providing information to inform better choices. Many of the studies looked at how effectively different labelling schemes achieve this for different Latin American populations.

Box 3.2: The intervention ladder

The range of options available to government and policy makers can be thought of as a ladder of interventions, with progressive steps from individual freedom and responsibility towards state intervention as one moves up the ladder. In considering which 'rung' is appropriate for a particular public health goal, the benefits to individuals and society should be weighed against the erosion of individual freedom. Economic costs and benefits would need be taken into account alongside health and societal benefits. The ladder of possible policy action is as follows:

Eliminate choice. Regulate in such a way as to entirely eliminate choice, for example through compulsory isolation of patients with infectious diseases.

Restrict choice. Regulate in such a way as to restrict the options available to people with the aim of protecting them, for example removing unhealthy ingredients from foods, or unhealthy foods from shops or restaurants.

Guide choice through disincentives. Fiscal and other disincentives can be put in place to influence people not to pursue certain activities, for example through taxes on cigarettes, or by discouraging the use of cars in inner cities through charging schemes or limitations of parking spaces.

Guide choices through incentives. Regulations can be offered that guide choices by fiscal and other incentives, for example offering tax-breaks for the purchase of bicycles that are used as a means of travelling to work.

Guide choices through changing the default policy. For example, in a restaurant, instead of providing chips as a standard side dish (with healthier options available), menus could be changed to provide a more healthy option as standard (with chips as an option available).

Enable choice. Enable individuals to change their behaviours, for example by offering participation in an NHS 'stop smoking' programme, building cycle lanes, or providing free fruit in schools.

Provide information. Inform and educate the public, for example as part of campaigns to encourage people to walk more or eat five portions of fruit and vegetables per day.

Do nothing or simply monitor the current situation.

Figure 2: The Nuffield Intervention Ladder (Nuffield Council on Bioethics, 2007, p.42)

In Mexico, the most significant proportion of people (37.5%) who reported altering purchasing behaviour because of seeing OWLs said they did so for health concerns (Sagaceta-Mejía et al., 2025), but there is mixed evidence relating to how OWLs assist with making this decision. A study from Uruguay that used eye-tracking data in a real shopping environment found that 98% of participants knew about the FoPWLs, 46% of them knew they referred to harmful nutrients, but only 8% said that the FoPWLs have

increased their awareness of harmful nutrients and their health implications (Machín et al., 2023). This indicates that the real impact could be below the self-reported 37.5% recorded by Sagaceta- Mejía et al., particularly as the combination of eye-tracking data and real-life shoppers in a supermarket makes Machín et al.'s study the most robust of the evidence in this category.

Of the different FoPWL options, there is evidence that OWLs have the most impact on consumer perceptions and purchasing behaviour (da Silva Gomes et al., 2025a, 2025b). The Brazilian "high-in" scheme did not show any significant difference in helping participants identify the least healthy food when presented with three options (de Alcantara et al., 2026). OWLs performed significantly better than TFL, NutriScore or GDA – with 3x better odds for identifying the least harmful option and for identifying individual excess ingredients in research from Costa Rica (da Silva Gomes et al., 2025b) and almost 4x as likely to identify the least harmful option in another study from El Salvador (da Silva Gomes et al., 2025a). The data from Costa Rica found that OWLs were the only FoPWL that showed a significant impact for participants of lower education level or SES (da Silva Gomes et al., 2025b).

Another study found that adding "ultra-processed" warning labels to products did not have any significant impact on purchase intention or perception of product healthiness when compared to nutrient warning labels alone – and they only resulted in a 7% rise in participants recognising products as ultra-processed (51% - 58%) (D'Angelo Campos et al., 2024). Mothers in Chile associated foods featuring FoPWLs with increased levels processing, despite there being no specific label declaring this (Correa et al., 2022), suggesting that additional processing labels may not be necessary.

Two of the studies carried out qualitative research with mothers of young children in Peru (Diez-Canseco et al., 2024) and Chile (Correa et al., 2022). Both studies noted the mothers choosing to cook more at home to avoid eating so many foods with FoPWLs, and the participants in Chile mentioned experiencing "label fatigue" as so many products featured FoPWLs (Correa et al., 2022). The ubiquity of FoPWLs was also mentioned by 5% of shoppers in a Uruguayan study (Machín et al., 2023). FoPWLs were reportedly not very effective when placed on items that mothers in Peru considered essential that they already knew where unhealthy (e.g. butter) or that they desired (e.g. chocolate) (Diez-Canseco et al., 2024). This links with an assertion in Salgado et al.'s study, which noted that the minimal reformulation seen in candies could be because there's less impact in reformulating products people already regarded as unhealthy (Salgado et al., 2025).

These two qualitative studies (Correa et al., 2022; Salgado et al., 2025) are the least robust in terms of methodology and sample size included in this REA. They are included as it is essential to consider lived experience of people when it comes to determining

food policy – especially women, who make the majority of food decisions for families around the world (Hawkes et al., 2024).

Influence of marketing

FoPWL impacts can be reduced by other information on packaging – including techniques such as featuring images of fresh fruit and green colours (Cadena, Ares and Gantiva, 2026). Two studies noted changes to consumer behaviour and attention paid to FoPWLs when marketing techniques (MT) or health claims (HC) appeared on packaging (Cadena, Ares and Gantiva, 2026; França, de Alcantara, and Deliza, 2025) and one study from Peru found an increase in MT and HC on products that exceeded "high-in" levels of different nutrients after the implementation of FoPWLs (Saavedra-Garcia et al., 2022).

In Brazil, it was found that FoPWLs reduced the perceived healthiness of products in isolation, but there was an even greater effect in the other direction when branding and nutritional marketing appeared on packaging, with textual nutrition marketing claims having the largest impact (França, de Alcantara, and Deliza, 2025). In relation to this study, however, it is worth noting that it only used the Brazilian magnifying glass FoPWLs, which have been shown to be less effective than OWLs (da Silva Gomes et al., 2025a, 2025b) and its methodology used an online survey which 68% of participants (958 of 1406) failed to complete.

A more robust study also found similar results, however. Using eye tracking data to analyse young people's interaction with food packaging, a study in Colombia found that the presence of HCs on packaging significantly reduced the number of times that participants focused on FoPWLs, with women being more likely to engage with FoPWLs than men in every respect: to fixate more quickly, more often and for longer. The data showed that participants still noticed the warning labels, but the presence of HC reduced the attention paid to them (Cadena, Ares and Gantiva, 2026)

In Peru, after the introduction of FoPWL, MTs on foods and beverages on "high-in" products increased by nearly 10% (up to 82.1%), with products under this cut off reducing MTs by nearly 20% (Saavedra-Garcia et al., 2022). For beverages, HC increased 29% on "high-in" drinks and only 8.7% on "not high-in" drinks, and dairy drinks saw a drop in MTs but an increase in HCs – possibly indicating companies trying to counteract FoPWLs (Saavedra-Garcia et al., 2022).

Economic-related evidence

Wage and job impacts

The food industry often tries to resist interventions like FoPWLs on the grounds that they will cause economic damage and lead to job losses (Paraje et al., 2021). There is limited research on the economic impacts seen after FoPWL policies have been

implemented, but neither of the two studies in this REA found any such impact on jobs or wages in Chile or Peru (Díaz et al., 2023; Paraje et al., 2021).

In Chile, average real wages and aggregate employment were compared between sectors likely to be impacted by FoPWLs and sectors unlikely to be impacted, with no impact seen in either metric (Paraje et al., 2021). In Peru, the FoPWL policy also included the introduction of a sugar-sweetened beverage (SSB) tax a year prior to the implementation of FoPWLs and data showed no job or wage losses attributable to either policy (Díaz et al., 2023).

Possible reasons offered for the lack of impact seen were that reformulation occurred fast enough to meet demand or that demand didn't change enough to impact supply-side factors (Paraje et al., 2021) or that large firms are able to allocate resources to other areas and use NCS to reformulate products, or consumer demand moving to a different products made by the same companies (Díaz et al., 2023).

While the relative lack of studies in this area shows the need for more research (Paraje et al., 2021), the two studies found are robust, with strong methodologies which indicate better health outcomes can be pursued without resulting in economic hardship.

Purchase behaviour

An analysis of 22 commercially available products in Colombia found that FoPWLs significantly reduced purchase probability, and that the effect was additive: the more FoPWLs displayed on a product's packaging, the larger the reduction in purchasing intent (Rangel-Quinonez, Vecchio and Arenas-Estevez, 2025). The study also found a marginally significant inverse relationship between price and purchase probability: more expensive products being less impacted by FoPWLs, but it was noted that this could be a result of more expensive products having fewer FoPWLs in the first place.

In Chile, mothers from lower SES backgrounds felt excluded from buying healthy foods due to inability to afford them, feeling the government was telling them foods were unhealthy rather than help them afford healthy options (Correa et al., 2022).

Similarly to perceptions of product healthiness, OWLs were the most impactful FoPWL for impacting purchase intention, with participants in Costa Rica being twice as likely to purchase the least harmful option compared to the control group (da Silva Gomes et al., 2025b).

In research from Brazil featuring the magnifying glass FoPWLs, 53% of participants reported changing purchase decisions when seeing FoPWLs; of the 47% that did not, the most significant reasons given were desire/need for the product (27%), habit (19%), conscious decision to ignore the label (14%) and lack of healthy alternatives (12%) (de Alcantara et al., 2026). In Uruguay, 56% of participants reported changing their

shopping behaviour post-introduction of OWLs; among participants who bought products despite seeing OWLs similar reasons were given: liking the product (31%), wanting the product (28%), it was a present/gift (15%) and habit (10%) (Machín et al., 2023). In Mexico, 38.2% of participants reported modifying their purchase behaviour after the FoPWLs were introduced, and the reasons given for buying products despite seeing OWLs were similar: liking the product, habit or craving (Sagaceta-Mejía et al., 2025).

Implications & recommendations for policymakers

Taking into account Theis and White's "implementation viability components," (Theis & White, 2021, p.132), the evidence in this REA examines the consumption behaviours of country-wide populations over a sustained period of time. The budget of implementing FoPWLs is not discussed in these papers, but evidence suggests there is no economic cost (Díaz et al., 2023; Paraje et al., 2021); the responsible agents in each case are national governments (with specific departments varying depending on the country). Different theories of change emerge from this research, with some studies showing the supply-side effects of how FoPWLs drive reformulation, reducing nutrients of concern in the food supply (Cadena, Gallo and Soto, 2025; Mamani-Urruti, Durán-Galdo and Bustamante-López, 2025), and others demonstrating their demand-side impact on consumer behaviour (Sagaceta-Mejía et al., 2025; Diez-Canseco et al., 2024).

This evidence base leads to the following policy recommendations:

Use OWLs when possible

The evidence shows that OWLs outperform other FoPWL options, with participants in two studies having a 3-4x greater chance of identifying the least healthy option out of three products when compared to the control (da Silva Gomes et al., 2025a, 2025b). For targeting general populations, OWLs were more effective than TFL, NutriScore and GDA labels and were the only FoPWLs which demonstrated a significant impact on people from low SES or education backgrounds (da Silva Gomes et al., 2025b). There is also evidence from Brazil that the "high-in" magnifying glass FoPWLs had no noticeable impact on consumers' ability to select the healthiest products (de Alcantara et al., 2026).

Implement FoPWLs with multiple different nutritional warnings

There is evidence of an additive effect of FoPWLs, with consumers being progressively less likely to choose products with multiple labels (Rangel-Quinonez, Vecchio and Arenas-Estevez, 2025). While there are concerns about "label fatigue" and people feeling they see FoPWLs on everything (Correa et al., 2022; Machín et al., 2023), this doesn't seem to have a significant impact on consumption: the mothers in Correa et

al.'s study still noted altering their behaviour to buy fewer products with FoPWLs and only 5% of participants in Machín et al.'s study mentioned the number of labels.

Implementing multiple labels makes it possible to see the nutrients most effected by FoPWLs – for example the effectiveness of the NCS label but lesser impact of the caffeine label in Mexico (Salgado et al., 2025). This can help policy makers with monitoring and evaluation to determine where further interventions are needed – which can be aided by carrying out surveys in countries to understand broad eating habits (Scarpelli et al., 2020).

Target nutrients of concern rather than level of processing

Adding an "ultra-processed" warning label onto the Brazilian FoPWLs had no significant impact on the purchase behaviour of participants, and only increased their ability to recognise UPFs by 7% (D'Angelo Campos et al., 2024). There was also qualitative evidence from interviews with mothers in Chile that existing OWLs are already mentally associated with processed foods (Correa et al., 2022).

Consider labels for additives such as NCS

In countries such as Peru (Saavedra-Garcia et al., 2023), Chile (Sambra et al., 2020) and likely Colombia (Cadena, Gallo and Soto, 2025), reformulation has led to a rise in the use of NCS (replacing sugar). Mexico instead saw a reduction in NCS after the country implemented a specific FoPWL for sweeteners (Salgado et al., 2025) suggesting this is an effective way to curb the use of NCS. This is particularly important when it comes to children, with 90% of products studied in Peru aimed at children containing NCS (Salgado et al., 2025).

Run public health campaigns to change consumer behaviour

Public health campaigns are needed to ensure FoPWLs are understood throughout the population (de Alcantara et al., 2026; Diez-Canseco et al., 2024; Rangel-Quinonez, Vecchio and Arenas-Estevez, 2025). This supports a theory of change rooted in the need to change customer behaviour more than just at the point of sale, aided by the studies that found "habit" as a reason that people bought products despite seeing FoPWLs (de Alcantara et al., 2026; Machín et al., 2023; Sagaceta-Mejía et al., 2025).

Regulate marketing techniques (MT) and health claims (HC) on packaging with FoPWLs

Evidence shows that MT and HC reduce the effectiveness of FoPWLs (Cadena, Ares and Gantiva, 2026), and that companies increase the use of these strategies in response to FoPWLs (Saavedra-Garcia et al., 2022).

Resist arguments from food companies citing potential economic harm

Evidence from Chile and Peru shows no impact on jobs or wages after the introduction of FoPWLs, despite industry claims that this would happen (Díaz et al., 2023; Paraje et al., 2021). While this does not relate directly to government budgets or spending, it is evidence that suggests FoPWLs can be implemented without economic cost.

Suggestions for further research

There are still a number of questions that need investigating relating to reformulation, specifically: to assess whether this leads to better overall nutritional quality (Rangel-Quinonez, Vecchio and Arenas-Estevez, 2025), to investigate the accuracy of nutrients being declared on labels by carrying out investigations in laboratories (Cadena, Ares and Gantiva, 2026), and to investigate whether reformulation leads to increased levels of processing and therefore a rise in the consumption of UPFs (Salgado et al., 2025) – particularly through the use of NCS (Sambra et al., 2020).

Analyses of demographics that need to be reached could also help better target campaigns (Cadena, Ares and Gantiva, 2026) and more research is needed into the economic impacts of FoPWL policies as this is currently an under-researched area (Paraje et al., 2021; Díaz et al., 2023).

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Appendix 1: Method

To conduct the evidence review for this REA, combinations of various search terms related to processing, ultra-processing, food, labelling, non-communicable diseases, spending and investing were used. For each of these, a root/stem word or phrase was used and truncated when searching to catch all relevant uses of the term in as wide a range of papers as possible (e.g. "ultra-process*" to get results featuring "ultra-processed", "ultra-processing", "ultra-processed food" etc.). Six different searches were conducted across both Academic Search Ultimate and Scopus, limited to peer-reviewed journals published in the last 5 years. A full breakdown of these searches and the papers they returned can be seen in the below table, "Table 1: Search Strategy".

The PICO framework to arrive at these search terms. The chosen population was the general population of Central and South America; the intervention examined was front-of-pack warning labels (FoPWL); the comparison to analyse was the consumption of UPF before and after their introduction; the outcomes the REA aimed to assess were impacts in the health and economic spheres. The searches delivered a manageable amount of results without the need to add specific population-related search terms, so papers not related to the target population were filtered out when screening abstracts. In relation to the other search terms, searching for specific conditions (e.g. obesity) was too restrictive, whereas searching for more generic terms such as "non-communicable disease*" made sure not to miss any relevant results. This broad approach was found to be similarly helpful with searches like "label*", "process*" and "consum*".

The searches returned 363 relevant papers, of which 159 were duplicates. The abstracts of the remaining 204 papers were screened (by me) using Rayyan, with papers excluded that were not specifically related to health and/or economic outcomes of FoPWLs in (South and Central America. In the process of investigating these papers, one paper (Paraje et al., 2021) was found by "snowballing" from the bibliography of Diaz et al. (2023).

The 20 selected papers were then analysed using Qualtrix and Google Sheets to generate robustness and relevancy scores (Table 2) according to the framework set out by Collins et al. (2015). The relevant evidence each paper contained for health and economic outcomes of FoPWLs in South and Central America was then also collected (Table 3). This evidence, along with the robustness and relevancy scores were then used to write up the REA and determine the recommendations for policy makers.

Appendix Table 1: Search strategy

Database	Date of search	Dates searched	Search terms	No of papers retrieved	No of relevant papers	Papers selected for review
Academic Search Ultimate	18/12/2025	01/01/2020 – Present	**Search 1** "Warning Label*" AND "process*"	99	31	Díaz et al., 2023 **Snowball from Díaz et al., 2023:** Paraje et al., 2021 de Alcantara et al., 2026 Cadena, Ares and Gantiva, 2026
Scopus	18/12/2025	01/01/2020 – Present	**Search 1** "Warning Label*" AND "process*"	149	78	Correa et al., 2022 Scarpelli et al., 2020 Saavedra-Garcia et al., 2022 Saavedra-Garcia et al., 2023
Academic Search Ultimate	18/12/2025	01/01/2020 – Present	**Search 2** Label* AND UPF	46	16	Cadena, Gallo and Soto, 2025
Scopus	18/12/2025	01/01/2020 – Present	**Search 2** Label* AND UPF	54	11	D'Angelo Campos et al., 2024
Academic Search Ultimate	18/12/2025	01/01/2020 – Present	**Search 3** "Warning label*" AND "Non-communicable disease*"	20	15	Salgado et al., 2025 França, de Alcantara, and Deliza, 2025
Scopus	18/12/2025	01/01/2020 – Present	**Search 3** "Warning label*" AND "Non-communicable disease*"	30	27	da Silva Gomes et al., 2025a da Silva Gomes et al., 2025b Machín et al., 2023 Sambra et al., 2020

Academic Search Ultimate	18/12/2025	01/01/2020 – Present	**Search 4** "Warning label*" AND "Ultra-process*" AND price*	4	3	/
Scopus	18/12/2025	01/01/2020 – Present	**Search 4** "Warning label*" AND "Ultra-process*" AND price*	3	3	Rangel-Quinonez, Vecchio and Arenas-Estevez, 2025
Academic Search Ultimate	19/12/2025	01/01/2020 – Present	**Search 5** "Ultra-process*" AND Label* AND Price* OR Spend* OR Invest*	42	24	Mamani-Urruti, Durán-Galdo and Bustamante-López, 2025
Scopus	19/12/2025	01/01/2020 – Present	**Search 5** "Ultra-process*" AND Label* AND Price* OR Spend* OR Invest*	41	25	Sagaceta-Mejía et al., 2025
Academic Search Ultimate	20/01/2025	01/01/2020 – Present	**Search 6** Label* AND Consum* AND UPF* OR "Ultra-process*"	100	43	/
Scopus	20/01/2025	01/01/2020 – Present	**Search 6** Label* AND Consum* AND UPF* OR "Ultra-process*"	169	87	Diez-Canseco et al., 2024

Appendix Table 2: Robustness and relevancy scores

Paper reference	Evidence type	Robustness score	Relevancy score	Combined score
Cadena, Gallo and Soto, 2025	Quantitative: observational	2	3	**6**
Cadena, Ares and Gantiva, 2026	Quantitative: experimental	2	3	**6**
Correa et al., 2022	Quantitative: experimental	1	3	**3**
D'Angelo Campos et al., 2024	Quantitative: experimental	2	3	**6**
da Silva Gomes et al., 2025a	Quantitative: experimental	2	2	**4**
da Silva Gomes et al., 2025b	Quantitative: experimental	2	2	**4**
de Alcantara et al., 2026	Quantitative: experimental	3	3	**9**
Díaz et al., 2023	Economic study	3	3	**9**
Diez-Canseco et al., 2024	Qualitative: Interviews	1	3	**3**
França, de Alcantara, and Deliza, 2025	Quantitative: experimental	1	2	**2**
Machín et al., 2023	Quantitative: experimental	3	3	**9**
Mamani-Urruti, Durán-Galdo and Bustamante-López, 2025	Quantitative: observational	2	3	**6**
Paraje et al., 2021	Economic study	3	3	**9**
Rangel-Quinonez, Vecchio and Arenas-Estevez, 2025	Quantitative: experimental	2	3	**6**
Saavedra-Garcia et al., 2022	Quantitative: observational	2	3	**6**
Saavedra-Garcia et al., 2023	Quantitative: observational	2	3	**6**
Sagaceta-Mejía et al., 2025	Quantitative: experimental	1	3	**6**
Salgado et al., 2025	Quantitative: observational	2	3	**6**
Sambra et al., 2020	Quantitative: observational	2	3	**6**
Scarpelli et al., 2020	Quantitative: observational	2	3	**6**

Appendix Table 3: Food system outcomes Identified

Paper reference	Outcome (Health)	Outcome (Economic)
Cadena, Gallo and Soto, 2025	From 2015 to 2024 in Columbia, median sugar content in beverages reduced by 46% (8.9g to 4.8g per 100ml), and in foods by 24% (10.7g to 8.1g per 100g). Sodium content in food products reduced by 26% (400mg to 296mg per 100g), but increased by 81% in beverages (8.3g to 15g per 100ml). Significant decreases were seen in energy counts seen in both beverages and processed meats: carbonated beverages' energy levels decreased by 51% (41 kcal to 20 kcal per 100ml), juice by 55% (44 kcal to 20 kcal per 100ml). Saturated fat in processed meat reduced by 34%. In food there were increases in calcium and iron, and a decrease in zinc. There was no significant micronutrient change in beverages. 85% of products complied with the mandatory sodium labels, and 87% with the mandatory sugar labels. Additionally, 12% of the products displayed the sodium label and 3% displayed the sugar label despite being within the limit. The study accepts that reductions in calorific content are likely a result of the use of non-caloric sweeteners. 32 of the 38 beverage products have reduced their sugar content to below the tax cut off (< 5 g of sugars per 100 ml).	/
Cadena, Ares and Gantiva, 2026	The presence of health claims (HC) on labels didn't have a significant impact on whether participants fixated on WLs, but it did have a significant effect on the number of times the WLs were fixated on. When packaging was neutral, participants fixated on WLs more times than when packaging featured HCs (2.37 times vs. 2.18 times $p = 0.021$, $d = 0.09$). There was also a negative value in terms of attentional bias (−0.32 s $p = 0.039$, $d = 0.11$), suggesting packages that did not feature HC led to participants focusing more attention on WLs. In terms of gender, women were more likely than men to fixate on WLs (OR = 1.54, $p = 0.001$), to fixate on them more quickly (2.9 s vs 3.2 s, $p = 0.014$, $d = 0.18$), fixate on them for longer (0.77 s vs 0.65, $p = 0.011$, $d = 0.15$) and fixate on them more times overall (2.33 vs 2.11 times, $p = 0.026$, $d = 0.12$).	Participants were more likely to purchase products with HC on their packaging (4.2 vs. 3.7 points, $d = 0.15$).

	Participants perceived products to be healthy at significantly higher rates when HC were present on packaging (5.9 vs 5.4, d = 0.21)	
Correa et al., 2022	FOPLs in Chile led to "label fatigue" (5) as mothers noted seeing labels on most products when out shopping, but this did give them dietary knowledge about which foods contained more critical nutrients. The mothers in the study associated FOPLs with more processed foods, despite the Chilean labels focusing on nutrients rather than on processing. This, combined with the COVID pandemic, led to mothers from all SES choosing to make more food at home and reduce processed food intake. Schools play a key role in how well the labels function to change eating habits – particularly in the way they caused children to understand the FOPLs and start being change-makers by asking for healthier food at home. When the schools shut during Covid, mothers noticed children's awareness of health labelling reduce.	The presence of FOPLs on many products on the supermarket led to many mothers choosing to prepare more food at home rather than buy processed foods. Mothers from lower SES backgrounds noted that prices of healthy foods meant they were excluded from buying them The dietary knowledge gained by the mothers led to them having a greater awareness that healthy food is more expensive and less accessible. This is particularly true for lower SES mothers, many of whom were annoyed that the government was labelling food as unhealthy rather than helping them afford the healthy options.
D'Angelo Campos et al., 2024	The addition of ultra-processed warning labels had no significant impact on purchasing intentions, perceptions on the healthiness of products or the perceived effectiveness of labels when compared to nutrient warning labels alone. There were no significant differences in these results by age, race, gender, education, current health or understanding of UPF. The addition of ultra processed warning labels led to more people identifying the products they were being shown as UPFs (58% vs 51%), but this did not impact their perceptions or purchase intentions. This also means that 42% still couldn't identify UPFs even with the labels, despite the cohort of the study being very well educated. Around 4% of participants indicated a positive view of UPF – understanding the phrase to mean "good-quality" or "sophisticated".	Adding an ultra-processed warning label did not significantly impact purchasing intention for products when compared with nutritional warning label alone.
da Silva Gomes et al., 2025a	Octagonal warning labels (OWLs) were the most effective FOPL scheme (when compared to traffic-light labelling and guideline daily amounts). Participants were 2x as likely to intend to purchase the least harmful option with an octagonal warning label present when compared to the control group (with traffic-light labelling participants were 49% more likely, and no change was seen with guideline daily amounts).	/

	Octagonal warning labels also performed best for participants correctly identifying the least harmful option (a 377% increase compared to the control group) and identifying products high in sodium, fat, saturated fat and/or sugar.	
da Silva Gomes et al., 2025b	Octagonal Warning Labels (OWL) performed better than traffic-light labelling (TFL), Nutriscore (NUS), guideline daily amounts (GDA) or the control group for identifying least harmful foods. OWLs resulted in 3x higher odds for identifying the least harmful option (as opposed to 89% for TFL, 57% for NUS and 19% for GDA). It was also the only FOPL system that significantly improved the ability of participants to identify the least harmful option across all categories of products in the study. Similarly, OWLs were more effective in identifying products with excessive amounts of sodium, sugars and/or saturated fats. OWLs were the only FOPL that had a significant impact for participants with a lower education level, shopping in a low SES neighborhood, with a reported NCD or over 50 years old. OWLs improved the odds significantly of members of these groups intending to purchase the least harmful option, with other FOPLs ineffective.	The odds of purchasing the least harmful option were 2x higher when exposed to OWLs when compared to the control group – with other FOPLs being ineffective.
de Alcantara et al., 2026	No significant difference was found in participants' ability to identify the healthiest product when "High-in" FOPLs were added to food labels. The addition of "High-in" labels to granola and toast did lead to significant increases in participants indicating the harmful nutrients in these products (sugar and sodium respectively), and a decrease in participants erroneously indicating that the crackers contained excess sugar – suggesting a better ability to understand the nutrient content of foods. 63% of participants exposed to them noticed the black magnifying glass "High-in" FOPLs, and of that number 92% said they took them into account when answering the survey. This did not lead to any improvement in identifying the healthiest product out of a set of 3, but did have a significant impact on participants' ability to identify excessive nutrient content in products.	Of people who noticed the labels, 53% reported that they changed their purchase decisions. When shopping, 30% of participants reported having seen the "High-in" labels when intending to purchase a product. On seeing these, 25% said they didn't purchase that product or a similar product, 17% opted to purchase a similar item that had fewer WLs, and 11% for a product with no WLs at all. In terms of the 47% of participants who did not change purchase decisions in light of the "High-in" labels the most significant reasons for this were: desire/need for the product (27%), habit (19%), a conscious decision to ignore the label (14%), lack of healthy alternatives available (12%),
Díaz et al., 2023	/	There was no resultant job or wage losses from the introduction of Peru's SSB tax and FOPL policy. Possible explanations given are: large firms able to reallocate labour resources, nonnutritive

		sweeteners enabling reformulation of products to avoid taxation or labelling, demand for products isn't significantly impacted by FOPLs, or consumer demand simply moves to a different product manufactured by the same firm that doesn't have FOPLs.
Diez-Canseco et al., 2024	The majority of mothers in the study recalled the warnings and understood their purpose. The mediums they remembered seeing them through were TV adverts, processed foods, billboard advertisements, social media and supermarket leaflets. WLs were not as effective when it came to products that were considered essential and already known to be unhealthy (e.g. butter) or in reducing consumption of products that were seen as enjoyable (e.g. chocolate). Most of the mothers reported reductions in both the frequency and quantity of processed foods they ate – many opting to cook more at home to avoid consuming products with WLs. In terms of specific nutrients, "sugar" was very well understood, but "saturated fats" and "sodium" less so – particularly for mothers from lower SES. The mothers reacted with a feeling of being scammed when finding out that products previously assumed to be healthy, or targeted at children (such as yoghurts and milks) were shown to be potentially harmful.	The WLs led to mothers across both SES analysed to reduce the frequency and quantity of processed foods they consumed. Most participants said that the impact of the WLs reduced over time – but that this could be because they had already changed purchasing habits as a result of their initial implementation.
França, de Alcantara, and Deliza, 2025	WLs reduced the perceived healthiness of products across all categories, but branding and nutritional marketing claims had an even greater impact on increasing perceived product healthiness. Textual nutritional marketing claims was the most influential individual factor in product healthiness perception.	/
Machín et al., 2023	98% of participants knew about the WLs, and 5% of them commented that WLs were on almost every product now. There was broad understanding that the WLs were health-related, and 46% of participants knew they referred to excess of harmful nutrients. 13% of participants who said they had altered their purchase decisions due to the WLs mentioned non-communicable diseases, and 6% said the WLs were predominantly an influence when shopping for their children. 8% of participants said that the WLs have increased their awareness of harmful	Only 7% of consumers fixated their gaze on WLs when shopping. 56% of consumers declared that their food choice decisions had changed since the Uruguay's FOPL policy was implemented, but 72% of participants in the study who declared having seen a WL purchased the product anyway. The main reasons for this were: liking the product (31%), wanting the product (28%), it was a request or present (15%) and habit (10%). Only 23% of participants compared within-category products when making purchase decisions. 77% immediately went to the product they wanted. 33% of participants decided not to purchase a product after declaring they had seen the WLs; 16% of these people purchased a different

	nutrients in products and potential negative impacts on their health. 5% of participants said they didn't modify their purchase decisions because no products without WLs were available, and 4% noted the comparatively high cost of healthy food. Participants searched for WLs when making purchase decisions more frequently than back-of-package nutrition labelling.	product without WLs and 84% did not purchase anything. 56% of participants reported that they had modified their decisions when purchasing food as a result of the WLs being introduced. 70% of these people said they try not to buy food with WLs and 11% said they substituted for other products with fewer/no WLs.
Mamani-Urruti, Durán-Galdo and Bustamante-López, 2025	There were significant reductions in key nutrients across both implementation stages of Peru's FOPL policy. After the WLs were brought in, there was a 10-30% decline across all the nutrients of concern (except trans fats, which remained the same). Sugar content in liquid UPFs fell 49% during the first phase of the implementation. Across the total implementation period, on average calories decreased 3.4%, sodium by 14%, sugar by 36.7% and saturated fats by 9.2%.	/
Paraje et al., 2021		There was no impact on aggregate employment and average real wages when data was compared with sectors not likely to be impacted by the legislation. There was a possible decline in production in sectors where products would be impacted by FOPL, but employment didn't fall. Possible reasons for this could be that reformulation was fast enough that companies weren't impacted or demand did not decrease enough to impact the supply-side of company operations, but this was not examined by the study.
Rangel-Quinonez, Vecchio and Arenas-Estevez, 2025		The presence of WLs had a significant impact in reducing purchase probability for 20 out of 22 foods, with a clear additive effect (more labels caused a bigger reduction in purchase probability). Customers with higher education levels and who were familiar with FOPLs were less impacted by the WLs than those with lower amounts of education or familiarity. The presence of 4 WLs had the largest impact, whereas there was minimal impact on products with only 1 WL. There was a marginally significant inverse relationship between the price of products and participants' purchase probability. This suggests that more the purchase probability of more expensive products is less impacted by WLs than cheaper items. The study notes that this could be a result of higher priced items often having fewer WLs than cheaper ones.
Saavedra-Garcia et al., 2022	Marketing techniques across three categories (dairy drinks, desserts and snacks) reduced significantly after FOPLs were introduced – with dairy drink MTs	Marketing techniques (MT) were present on nearly 70% of products, and health claims (HC) on more than 80% of beverages across all stages of policy implementation. Throughout the stages

	aimed at children reducing significantly On the other hand, bakery products saw a significant increase in MTs. Dairy drinks and breakfast cereals had a higher proportion of HCs (from 50% to almost 75%) in both phases than other product types. MTs on foods and beverages impacted by the "high-in" FOPLs increased by nearly 10% (to 82.1%), whereas for products that weren't "high-in", MTs reduced by nearly 20% (to 63%). HCs on "high in" beverages increased 29%, whereas on not "high in" foods and beverages the increase was only 8.7%. In relation to dairy drinks (on which MTs decreased but HCs increased) a possible explanation is companies trying to counteract the negative health implications of the FOPWLs.	of implementation, MT on products that were "high-in" harmful nutrients increased from 73.6% to 82.1% and HC on products that were not "high-in" increased from 32.9% to 41.6%. These increases may be a response by food companies to mitigate the impact of WLs on food sales.
Saavedra-Garcia et al., 2023	Comparing data before and after the implementation of Peru's FOPWLs, median sugar content of beverages decreased (from 9.0 to 5.9 g/100 mL, p = 0.005) and there was also an observed increase in nonnutritive sweeteners (the use of these rose from 34.5% to 62.1% of beverages). This resulted in the proportion of beverages that would be required to display a WL falling from 59% to 31%. A similar reduction was seen in saturated fats; comparing before and after the policy, the number of products that would have a WL for this fell from 82% to 62%. Across all foods, the use of nonnutritive sweeteners rose from 15.4% to 20%. The most significant changes were seen between the first and second collections (the initial phase of policy implementation). There was no evidence found of further reformulation after the first phase. There was no significant change in sodium content of foods or beverages.	/
Sagaceta-Mejía et al., 2025	The most significant driver among participants who modified their purchasing behaviour was health concerns (37.5%).	38.2% of participants reported modifying purchase behaviour after the introduction of FOPWLs, with the greatest impacts being seen among women and people over 60 years old. Of these people, 38.7% said they did not buy a product, 30.5% bought something else with fewer WLs, 23.2% bought less of the product than they would have if it had displayed no WLs, and 7.7% bought something else with no WLs. 67.5% of participants for whom WLs didn't alter their purchase behaviour said this was because of liking the product, out of habit or craving.
Salgado et al., 2025	There was product reformulation in Mexico after the FOPL policy was implemented,	/

	which resulted in reductions of harmful nutrients and calories in the Mexican food and beverage supply. The reformulation of products occurred mainly in the second phase of the policy's implementation. Instant food requiring at least one WL fell from 77.8% to 52.6%, and there were reductions in the need for at least one type of WL across all food groups. Products with excess sodium fell by up to 63.1% in bread and cereals, saturated fat by up to 26.3% in salty snacks, and non-caloric sweeteners by up to 29% in solid dairy products. Non-caloric sweeteners also fell from being in 12.4% of salty snacks after the first implementation of the policy to 0% after the second. The reduction seen in non-caloric sweeteners stands out from other studies. In Chile and Peru the use of these rose with reformulation – both of these countries did not have a NCS WL as part of their policy. There was no meaningful change seen in caffeine content in sweetened beverages. As with NCS, Mexico was the first country to implement caffeine WLs. There was also minimal reformulation of candies. A possible reason being reformulation is unlikely to alter health perception of a product type already considered to be unhealthy.	
Sambra et al., 2020	Out of all products analysed, 55.5% were found to contain at least one NCS (non-caloric sweetener). By product type this included: 67.1% of dairy, 31.5% of cereal, 49% of processed fruits, 74.3% of non-alcoholic beverages, and 46.2% of sweets and desserts. NCSs were present in 100% of flavoured waters. The second highest rate of NCS in food is Brazil at 24.4% (less than half that found in Chile) NCS highly prevalent in products aimed at children, especially powder juices (98.8%) and flavoured milks (98.3%), jellies (91.2%) and dairy desserts (79%). The most common NCS types were sucralose and steviol glycosides – with low use of saccharin and cyclamate. 80 tabletop NCS options were also available for purchase at a local market. It is very plausible that daily consumption of NCS among children could be exceeding the acceptable daily intake. There are no NCS-free alternatives for certain food categories, even for children.	

	Companies have been using NCS in Chile to avoid their products having WLs – particularly "high-in sugar".	
Scarpelli et al., 2020	In the 476 products analysed pre- and post-the implementation of Chile's Food Labeling and Advertising Law, total sugar content saw a 15% reduction, with dairy, confitures and sugary beverages seeing the largest decrease in energy and sugar content. Sodium saw a decrease of 9.2%, energy of 3.9% and saturated fat of 1.5%. During the study period, all food groups saw at least one reduction. In the majority of food and drink categories, energy, total sugar and sodium saw significant reductions as companies reformulated products in response to the policy. Dairy products saw a 62.5% reduction in total sugar, and sugary beverages saw a 52.2% reduction in energy. This could have an impact on the energy intake and the consumption of nutrients of concern in children. There was little change in the nutrient content of products that are harder to reformulate (e.g. pastry, ice cream and desserts).	