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Health impacts of ultra-processed foods on non-communicable diseases: Community interventions and policy approaches for prevention

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Abstract

Ultra-processed foods, industrially formulated products defined by the NOVA classification as formulations dominated by cosmetic additives and stripped of intact whole foods, now dominate dietary energy intake in high-income countries and are advancing rapidly across low- and middle-income regions, displacing minimally processed staples and fuelling the global non-communicable disease crisis. Convergent evidence from umbrella reviews of meta-analyses, large prospective cohorts, and controlled feeding trials demonstrates consistent dose-response associations between higher ultra-processed food consumption and elevated risks of obesity, type 2 diabetes, cardiovascular disease, selected cancers, depression, and all-cause mortality, associations that persist after rigorous adjustment for nutrient quality and lifestyle confounders. Mechanistic investigations reveal that these harms arise not only from hyper-palatability and energy overconsumption but also from additive-driven gut dysbiosis, impaired intestinal barrier function, and sustained low-grade inflammation, pathways that operate independently of conventional nutrient profiling. Community interventions in schools, workplaces, and food pantries have shown that targeted environmental redesign and behavioural support can meaningfully reduce intake, yet their impact remains limited without broader structural change. Policy instruments front-of-pack warning labels, child-directed marketing bans, selective taxation and public procurement standards have delivered measurable declines in purchases and prompted reformulation in pioneering Latin American settings, proving most potent when implemented as integrated packages that address product formulation, marketing, affordability, and supply chains simultaneously. This review synthesizes the epidemiological, mechanistic, and intervention evidence to argue that shifting from nutrient-centric to processing-based dietary guidance, coupled with equity-focused regulatory action, offers the most promising route to curbing ultra-processed food dominance and reversing the non-communicable disease epidemic.

Keywords: Ultra-Processed Foods; Non-Communicable Diseases; NOVA Classification; Community Interventions; Food Policy; Front-Of-Pack Labelling; Marketing Restrictions; Prevention Strategies

1. Introduction

Ultra-processed foods (UPFs) now dominate many modern diets and have risen in parallel with the global burden of non-communicable diseases (NCDs) including obesity, type 2 diabetes, cardiovascular disease, and selected cancers. The NOVA system classifies these products according to the nature, extent, and purpose of industrial processing. This

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review examines the health effects of UPFs on NCDs together with community interventions and policy measures that can support prevention, paying particular attention to settings where consumption is increasing most rapidly.

1.1. The NOVA Classification System and Definition of Ultra-Processed Foods

Monteiro et al. [1] developed the NOVA food classification system to group foods according to the extent and purpose of industrial processing rather than nutrient content alone. In this framework, Group 1 comprises unprocessed or minimally processed foods such as fresh fruits, vegetables, grains, and meats. Group 2 includes processed culinary ingredients such as oils, sugars, and salt. Group 3 covers processed foods made by combining Groups 1 and 2, while Group 4 consists of ultra-processed foods. These industrial formulations are typically made mostly or entirely from substances extracted from foods or derived from food constituents, often with little if any intact Group 1 food, and usually contain cosmetic additives including flavours, colours, emulsifiers, and sweeteners.

In their practical guide, Monteiro and colleagues [1] further explained that UPFs can be identified by examining ingredient lists for substances rarely used in domestic kitchens, such as high-fructose corn syrup, hydrolyzed proteins, or modified starches, together with additives whose function is to enhance palatability, appearance, or shelf-life. This processing-based lens distinguishes UPFs from other categories and has become widely adopted in epidemiological work precisely because it captures industrial formulation beyond simple nutrient profiling. Subsequent applications of NOVA have consistently shown that these products are engineered for hyper-palatability and long shelf-life, features that set them apart from minimally processed alternatives [2].

Although some boundary cases continue to spark discussion, the NOVA system's operational clarity has allowed consistent cross-study and cross-regional comparisons. Systematic evaluations confirm that NOVA remains the classification most frequently applied when linking processing extent to health outcomes, thereby providing a solid foundation for the analyses presented in this review [1, 3]. Findings from a related FAO report by the same lead authors reinforce that UPFs are not merely convenient but are designed to displace all other NOVA groups, notably unprocessed or minimally processed foods [4].

1.2. Global and Regional Consumption Patterns of Ultra-Processed Foods

Consumption of UPFs has increased markedly in recent decades, especially in high-income countries where these products now account for 50 % or more of total dietary energy in many populations. National dietary surveys show that younger adults and lower-income groups frequently record the highest intakes, pointing to clear socioeconomic gradients in exposure. Urbanization, time pressures, and intensive marketing have all contributed to this shift away from traditional food preparation [2].

In low- and middle-income countries the overall contribution of UPFs remains lower, yet sales and intake data reveal rapid acceleration, particularly in urban areas of Latin America, Asia, and Africa. Ready-to-eat snacks, sugary beverages, and packaged meals are displacing staple-based diets, reflecting broader changes in food systems that favour affordable, convenient, and heavily marketed products. These transitions mirror the nutrition transition observed earlier in high-income settings. According to Matos et al. [5], concurrent rises in UPF intake and NCDs are especially pronounced across Latin American countries, where household-level data document a clear displacement of minimally processed foods.

Higher UPF intake is consistently associated with lower consumption of fruits, vegetables, whole grains, and other minimally processed foods, thereby reducing overall diet quality. Although regional differences in absolute levels persist, the direction of change is uniform: UPFs continue to expand their share of energy intake even in populations whose traditional diets were previously protective [2, 5]. A systematic review by Vitale et al. [6] further highlights that these patterns hold across multiple observational datasets, underscoring the global nature of the dietary shift.

1.3. Association Between Ultra-Processed Foods and Non-Communicable Diseases

An umbrella review of epidemiological meta-analyses by Lane et al. [2] reported consistent positive associations between greater UPF exposure and a range of adverse health outcomes spanning cardiometabolic, mental, and mortality domains. After adjustment for overall diet quality and other confounders, higher consumption remained linked to increased risk of cardiovascular disease, type 2 diabetes, and all-cause mortality.

In a complementary umbrella review and updated meta-analysis, Dai et al. [3] synthesized 39 separate meta-analyses covering observational studies. Their work identified highly suggestive or convincing evidence for associations with overweight, obesity, diabetes, depression, and common mental disorders. The authors noted that these patterns held across diverse populations and study designs, adding weight to the observed relationships [3].

Many of the reported associations display a dose-response character: each incremental rise in the proportion of energy derived from UPFs elevates NCD risk independently of nutrient intake. Taken together, these large-scale syntheses position UPF consumption as a modifiable driver of the global NCD epidemic that merits targeted public-health action [3, 6]. Earlier narrative syntheses, such as that by Matos et al. [5], similarly document parallel trends between rising UPF availability and NCD incidence in Latin America, providing regional corroboration of the broader epidemiological picture.

1.4. Rationale and Objectives of the Present Review

The rapid rise in UPF consumption and its documented contribution to NCD burden make a synthesis of both health impacts and prevention strategies particularly timely. While many prior reviews have focused on disease-specific associations, fewer have brought together epidemiological evidence with evaluations of community programmes and policy instruments in a single narrative. This review seeks to fill that gap by integrating the latest high-quality meta-analytic findings with practical intervention and policy data [3, 6].

The objectives are therefore fourfold: first, to summarize the strongest epidemiological evidence linking UPFs to NCDs; second, to outline plausible biological mechanisms where data allow; third, to assess the effectiveness of community-level interventions; and fourth, to appraise regulatory and fiscal policies such as front-of-pack labelling, marketing restrictions, and taxes. Particular attention is paid to equity issues in low- and middle-income settings where UPF markets are expanding fastest [2, 5].

By adopting a structured narrative approach grounded exclusively in published meta-analyses and systematic reviews, this paper aims to offer researchers, practitioners, and policymakers a concise yet comprehensive resource. The ultimate goal is to translate scientific consensus into actionable recommendations that can slow UPF-driven NCD progression and promote more sustainable dietary patterns worldwide [1, 4].

2. Consumption Patterns and Epidemiology of UPFS

The epidemiology of ultra-processed food consumption reveals a clear upward trajectory that mirrors the rising incidence of non-communicable diseases across populations. National dietary surveys and systematic syntheses consistently document increasing reliance on UPFs, driven by industrial food systems that prioritize convenience, affordability, and aggressive marketing. This section reviews global and regional patterns, socio-demographic influences, and the displacement of minimally processed foods, highlighting the need for targeted surveillance to guide prevention efforts.

2.1. Global Consumption Trends

A systematic review by Marino et al. [7] examined data from 99 studies involving more than 1.3 million participants and found that UPFs account for a substantial share of dietary energy in many countries, frequently exceeding 50 % in high-income settings. The authors noted considerable variability across populations yet emphasized a consistent temporal increase in intake over recent decades. Such trends reflect broader shifts in food availability and consumer behaviour that warrant ongoing monitoring.

Findings from Baker et al. [8] indicate that this growth forms part of the global nutrition transition, whereby industrial formulations rapidly gain market share through transformed food systems. Their analysis of sales data and dietary surveys across continents shows that UPFs have become dominant in energy supply in several regions since the early 2000s. The authors link these changes to corporate expansion and urbanization, which together facilitate higher consumption irrespective of traditional dietary preferences.

Similar evidence emerges from repeated national surveys, where the contribution of UPFs to total energy intake has risen steadily even after adjustment for demographic factors [7, 8]. These patterns underscore the scale of dietary change and the importance of standardized NOVA-based assessment in future epidemiological work.

2.2. Regional Variations and Acceleration in Low- and Middle-Income Countries

In low- and middle-income countries, absolute UPF intake remains below levels observed in high-income nations, yet the rate of increase is particularly striking. Matos et al. [5] documented rapid growth in Latin America, where household purchases of UPFs rose markedly between 2000 and 2013 in most countries examined. Urban households showed the steepest increases, often at the expense of staple-based meals.

Baker et al. [8] similarly reported that sales growth in Latin America, Asia, and parts of Africa outpaced that in North America and Europe during the same period. The authors attributed this acceleration to greater retail penetration and exposure to global marketing, which together alter local food environments. Regional data therefore confirm that the nutrition transition is unfolding fastest where regulatory frameworks are still developing.

Although baseline consumption differs by country income group, the direction of change remains uniform [5, 8]. Continued surveillance in these settings is essential, as even modest percentage increases in UPF energy contribution can amplify population-level NCD risk.

2.3. Socio-demographic Determinants

Socioeconomic position strongly shapes UPF exposure. Dicken et al. [9] synthesized nationally representative cohorts and concluded that consumption varies systematically by age, education, income, and urban residence. Younger adults and urban dwellers typically record higher intakes, while patterns by income differ between countries.

In the United States, Baraldi et al. [10] analyzed nationally representative data from 2007 to 2012 and observed that UPF contribution to energy intake declined with increasing age and household income. The study also identified differences across racial and ethnic groups, with non-Hispanic Black and White participants showing higher adjusted intakes than other groups. These gradients highlight how structural factors influence dietary choices.

Additional reviews confirm that education level often modifies consumption independently of income [9, 10]. Collectively, the evidence points to persistent inequities in UPF exposure that must be addressed when designing community or policy interventions.

2.4. Dietary Displacement Effects and Surveillance Needs

Higher UPF intake is reliably associated with reduced consumption of minimally processed foods. Martini et al. [12] examined dietary profiles and reported that elevated UPF energy share corresponds to lower intakes of fibre, vitamins, and minerals from whole-food sources. The displacement effect appears consistent across age groups and geographic settings. Pagliai et al. [13] reached comparable conclusions in their broader synthesis, noting that UPFs not only crowd out nutrient-dense options but also contribute to poorer overall diet quality. The authors stressed that this substitution occurs even when total energy intake is controlled.

Lawrence [11] emphasized the value of routine NOVA-based surveillance to track displacement trends and evaluate policy impact. Their work calls for harmonized data collection methods that can capture both absolute intake and changes over time in diverse populations [12, 13]. Such surveillance remains critical for timely public-health responses.

3. Health Impacts of Ultra-processed Foods on Non-Communicable Diseases

Compelling observational evidence now links higher consumption of ultra-processed foods to a broad range of non-communicable diseases. Large prospective cohorts and multiple meta-analyses have quantified these associations after adjustment for overall energy intake, nutrient quality, and key lifestyle confounders. This section examines the strength and consistency of the evidence across major NCD categories, drawing on umbrella reviews and targeted systematic syntheses to clarify where the data are most robust.

3.1. Obesity and Metabolic Syndrome

A recent narrative synthesis by Dicken and Batterham [17] concluded that greater ultra-processed food intake consistently predicts weight gain and higher adiposity measures in adults. Their review of prospective studies showed positive dose-response relationships with body mass index, waist circumference, and overall obesity risk, even when dietary quality scores were included in multivariable models. The authors highlighted that cross-sectional data reinforce these patterns, although longitudinal evidence remains stronger for adults than for children.

Complementary meta-analyses have reported pooled odds ratios in the range of 1.36 to 1.55 for overweight or obesity when comparing highest versus lowest consumers [2, 17]. Abdominal obesity in particular appears elevated, with effect estimates around 1.41 after adjustment for physical activity and other dietary factors [17]. These associations hold across diverse populations, suggesting that processing-related characteristics contribute independently of nutrient composition.

Metabolic syndrome components also track with ultra-processed food exposure. Pooled data indicate increased odds of the syndrome itself, alongside individual features such as dyslipidaemia and elevated blood pressure [13, 18]. While residual confounding cannot be entirely excluded, the consistency across study designs strengthens the case for a genuine relationship at the population level.

3.2. Type 2 Diabetes

Longitudinal evidence points to a clear dose-response link between ultra-processed food intake and incident type 2 diabetes. Delpino et al. [19] performed a systematic review and meta-analysis of prospective studies and found that each 10 % increment in energy from ultra-processed foods was associated with roughly a 12 to 14 % higher risk. The authors noted moderate to high credibility of the evidence after applying GRADE criteria.

Similar findings emerged from an earlier synthesis by Moradi et al. [20], who pooled data from multiple adult cohorts and reported a statistically significant elevation in diabetes incidence among high consumers. Adjustment for body mass index only modestly attenuated the estimates, implying pathways beyond weight gain alone. Recent updates that incorporate larger sample sizes continue to support the original magnitude of effect [3, 19].

Mechanistic plausibility is reinforced by the observation that ultra-processed foods displace fibre-rich and minimally processed items known to protect against glycaemic dysregulation. Taken together, these meta-analyses position ultra-processed food consumption as a modifiable risk factor that operates across different stages of diabetes development.

3.3. Cardiovascular Disease

Prospective cohort data and meta-analyses demonstrate consistent associations between ultra-processed food intake and cardiovascular outcomes. Mendoza et al. [21] analyzed three large US cohorts together with a systematic review of 22 additional prospective studies; they reported 17 % and 23 % higher risks of coronary heart disease and overall cardiovascular disease, respectively, for highest versus lowest consumers. The meta-evidence quality was graded high for coronary heart disease.

Dose-response modelling further supports causality. Yuan et al. [22] examined prospective cohorts and identified positive linear relationships between ultra-processed food intake (by weight, servings, or energy proportion) and cardiovascular events. A 10 % increase in daily energy share from ultra-processed foods corresponded to approximately 1.6 % higher event risk after multivariable adjustment [22, 23].

Hypertension and cerebrovascular outcomes show comparable patterns, although effect sizes are sometimes smaller. Qu et al. [24] confirmed elevated risks of composite cardiovascular events in their dose-response meta-analysis, reinforcing the broader cardiometabolic harm signal observed in umbrella reviews [2, 21].

3.4. Cancer

Evidence for cancer outcomes is more heterogeneous yet still suggestive for several sites. Lian et al. [25] conducted a meta-analysis focused on site-specific risks and concluded that high ultra-processed food consumption was associated with significantly elevated odds of certain cancers, particularly colorectal. Their pooled estimates remained significant after sensitivity analyses.

Isaksen IM and Dankel SN [26] performed a broader systematic review and meta-analysis covering overall and several site-specific cancers. They found consistent positive associations for overall cancer incidence as well as colorectal cancer, with suggestive evidence for breast cancer in some subgroups [26]. The authors cautioned that confounding by lifestyle and screening behaviours requires careful interpretation.

Umbrella-level syntheses place these cancer associations in the suggestive to highly suggestive category, with effect sizes that are modest but clinically relevant at population scale [2, 3]. Longer follow-up and improved adjustment for competing risks will help clarify the precise contribution of ultra-processed foods to carcinogenesis.

3.5. Other Non-Communicable Diseases and Mortality

Beyond core cardiometabolic conditions, ultra-processed food intake has been linked to elevated all-cause mortality. Pooled hazard ratios from multiple cohorts range from 1.21 to 1.28 for highest versus lowest consumers after extensive adjustment [2, 27]. Cardiovascular mortality shows particularly strong associations in several analyses [21, 22].

Table 1 Summary of Key Epidemiological Evidence on Ultra-Processed Food Consumption and Major Non-Communicable Disease Outcomes

NCD Outcome	Study Design / Scope	Main Effect Size (highest vs lowest UPF intake)	Adjustment Factors Included	Evidence Strength / Notes	References
Overweight / Obesity	Umbrella review + narrative synthesis	OR 1.36–1.55	Diet quality, energy intake, physical activity	Highly consistent; dose-response	Lane et al. [2]; Dicken and Batterham [17]
Abdominal obesity	Umbrella review	OR ≈1.41	Lifestyle confounders	Independent of nutrient quality	Lane et al. [2]
Metabolic syndrome	Systematic review + meta-analysis	OR 1.36–1.81	Age, sex, BMI	Includes dyslipidaemia and hypertension	Shu et al. [18]; Pagliai et al. [13]
Type 2 diabetes	Meta-analysis of prospective cohorts	HR 1.24 (per 10% energy increment ≈12–14%)	BMI, diet quality, lifestyle	Moderate-to-high GRADE credibility	Delpino et al. [19]; Moradi et al. [20]
Cardiovascular disease	Prospective cohorts + meta-analysis	HR 1.17–1.23	Multiple lifestyle and dietary factors	Dose-response confirmed	Mendoza et al. [21]; Yuan et al. [22]
Coronary heart disease	3 large US cohorts + meta-analysis	17–23% higher risk	Extensive adjustment	High-quality evidence	Mendoza et al. [21]
Cancer (overall and colorectal)	Systematic review + meta-analysis	OR 1.12–1.24	Confounding by lifestyle and screening	Suggestive to highly suggestive	Lian et al. [25]; Isaksen et al. [26]
All-cause mortality	Umbrella review + cohort studies	HR 1.21–1.28	Diet quality, socioeconomic status	Robust after extensive adjustment	Lane et al. [2]; Fang et al. [27]
Depression and mental disorders	Umbrella review	OR 1.22–1.53	Baseline diet quality	Independent of socioeconomic position	Dai et al. [3]; Vitale et al. [28]
Frailty / multimorbidity	Systematic review and meta-analysis	Positive association	Age, comorbidities	Weaker but consistent signal	Vetrano et al. [29]

OR: Odds Ratio, HR: Hazard Ratio, BMI: Body Mass Index GRADE: Grading of Recommendations, Assessmentx, Development and Evaluation

Mental health outcomes also feature prominently. Systematic reviews document increased risks of depression and common mental disorders, with odds ratios around 1.22 to 1.53 [3, 28]. These relationships persist after controlling for baseline diet quality and socioeconomic position, raising the possibility of direct neuroinflammatory or gut-mediated pathways. Additional NCDs such as frailty, irritable bowel syndrome, and certain respiratory conditions in younger populations display weaker but still positive associations in available meta-analyses [3, 29]. Collectively, the breadth of outcomes underscores that ultra-processed foods may influence multiple physiological systems simultaneously, amplifying overall NCD burden.

Table 1 summarizes the principal findings from key umbrella reviews and meta-analyses on the association between ultra-processed food consumption and major non-communicable disease outcomes

4. Mechanisms Linking Ultra-processed Foods to Non-Communicable Diseases

While epidemiological data establish strong associations between ultra-processed food intake and non-communicable diseases, understanding the underlying biological pathways is essential for interpreting causality and designing effective interventions. Mechanisms operate through both nutritional and non-nutritional routes, often interacting to promote excess energy intake, metabolic disruption, and chronic inflammation. Randomized controlled feeding trials and experimental studies provide direct evidence that these pathways extend beyond simple nutrient imbalances, highlighting the unique properties of industrial formulations.

4.1. Nutritional Mechanisms

Ultra-processed foods are typically engineered for hyper-palatability through combinations of added sugars, fats, and sodium that stimulate reward pathways and encourage overconsumption. In a landmark inpatient randomized crossover trial, Hall et al. [30] demonstrated that participants consumed approximately 500 kcal more per day on an ultra-processed diet compared with a nutrient-matched unprocessed diet, leading to significant weight gain over two weeks. The diets were identical in macronutrients, sugar, fibre and energy density when presented, isolating processing as the key variable.

This excess intake appears driven by reduced satiety and faster eating rates rather than differences in postprandial hormones alone. Ultra-processed products often lack the physical structure and fibre matrix of minimally processed foods, which normally slow gastric emptying and enhance fullness signals. As a result, energy compensation is incomplete, contributing to positive energy balance over time [2, 12]. Juul et al. [31] further noted in their review of cardiometabolic pathways that the disrupted food matrix in ultra-processed items leads to rapid glycaemic responses and impaired gut–brain satiety signalling, amplifying overeating even when total energy density is controlled.

Observational data reinforce these experimental findings by showing consistent displacement of fibre-rich and protein-dense whole foods, further weakening satiety regulation [2, 12]. Collectively, these nutritional characteristics create a permissive environment for gradual weight gain and metabolic strain that accumulates across populations.

4.2. Non-nutritional Mechanisms Involving Food Additives

Beyond nutrient composition, cosmetic additives in ultra-processed foods exert direct effects on the gastrointestinal tract and systemic physiology. Suez et al. [32] reported in a seminal study that non-caloric sweeteners can induce glucose intolerance in both mice and selected human subsets by altering gut microbial composition and function. Subsequent work by the same group confirmed individual variability in microbiome responses, indicating that personalized effects may determine susceptibility to glycaemic impairment [33].

Rondinella et al. [34] reviewed the available literature and concluded that ultra-processed foods, through their high content of synthetic additives and emulsifiers coupled with low fibre, consistently reduce microbial diversity, lower populations of beneficial species such as *Akkermansia muciniphila* and *Faecalibacterium prausnitzii*, and elevate pro-inflammatory microorganisms. Whelan et al. [35] synthesized evidence on food additives in gut health and emphasized that emulsifiers and certain preservatives directly compromise barrier function and promote inflammation in both preclinical and limited human data.

Bevilacqua et al. [36] and Lavrinienko et al. [37] reached similar conclusions in narrative reviews, noting that sweeteners, emulsifiers, and thickeners disrupt eubiosis and contribute to the dysbiosis observed in habitual ultra-processed food consumers. Spiller et al. [38] additionally highlighted how these alterations exacerbate intestinal inflammation, linking additive exposure to pathways relevant for inflammatory bowel disease and broader systemic effects.

4.3. Systemic Effects and Integration of Evidence

The combined nutritional and additive pathways ultimately converge on chronic low-grade inflammation and impaired metabolic signalling. Elevated circulating lipopolysaccharide from compromised gut barrier function activates Toll-like receptors, triggering NF-κB pathways that promote hepatic and adipose tissue insulin resistance. Over time, these processes contribute to the cluster of abnormalities seen in metabolic syndrome and type 2 diabetes. Ciaffi et al. [39] conducted a scoping review and found consistent associations between ultra-processed food consumption and elevated systemic inflammatory markers in human studies, supporting the translation of preclinical findings to clinical populations.

Randomized trial data strengthen causal inference. The controlled feeding study by Hall et al. [30] not only documented overeating but also noted subtle shifts in inflammatory markers and appetite-regulating hormones that favoured continued consumption. When integrated with microbiome findings from Suez et al. [32, 33] and the broader additive reviews [36, 37, 38], the evidence suggests that ultra-processed foods act through multiple, partially independent routes that amplify each other.

Although longer-term human trials remain limited, the available mechanistic data indicate that reformulation or reduction strategies targeting both palatability and additive content could interrupt these cascades. Continued research is needed to disentangle the relative contributions of specific additives versus overall food matrix effects in free-living populations.

5. Community Interventions for UPF Reduction

Beyond individual dietary advice, community-level interventions offer practical ways to reduce ultra-processed food availability and consumption in everyday settings. These approaches target food environments such as schools, workplaces, food pantries, and local neighbourhoods, often combining education, substitution strategies, and environmental changes. Evidence from randomized trials, pilot studies, and real-world programme evaluations shows modest but promising reductions in UPF intake, particularly when interventions address both supply and demand. This section reviews key models, their outcomes, and implementation challenges, with emphasis on scalable examples from low- and middle-income countries.

5.1. School- and Workplace-Based Interventions

School feeding programmes provide one of the most widely studied platforms for limiting ultra-processed foods at the community level. In Brazil, the National School Feeding Programme (PNAE) has progressively restricted ultra-processed items through procurement rules that prioritize fresh or minimally processed foods. According to de Azevedo et al. [39], evaluation of food purchasing patterns under updated PNAE guidelines demonstrated substantial shifts toward unprocessed ingredients, with many municipalities achieving compliance through local family farm procurement.

Adherence to these healthier school meals has also been linked to lower obesity indicators among adolescents. Boklis-Berer et al. [40] analyzed nationally representative data and found a dose-response relationship: students eating school meals five times per week showed significantly lower BMI z-scores and reduced prevalence of overweight and obesity compared with lower-adherence groups. The authors attributed part of the benefit to the displacement of ultra-processed snacks and beverages outside school hours. Gombi-Vaca et al. [41] further examined the challenges of reducing UPFs in school meals in the United States and concluded that moving toward scratch cooking requires cross-sector support, including better procurement guidelines and infrastructure investment.

Workplace interventions remain less common but follow similar logic by improving cafeteria offerings and providing education. Preliminary findings align with school-based results, suggesting that institutional food policies can influence daily UPF exposure across different age groups [39, 40, 41].

5.2. Community and Food Pantry Programmes

Food pantries serving low-income households represent another important setting for community action. The UnProcessed Pantry Project (UP3) developed a framework that categorizes pantry stock according to processing level and actively promotes minimally processed alternatives. Carmen et al. [42] reported that implementation of UP3 led to measurable reductions in ultra-processed food availability within participating pantries, alongside client education sessions that improved selection of whole foods.

Participants in the UP3 pilot showed increased confidence in identifying and choosing less-processed options, although longer-term consumption changes required sustained support. The programme's emphasis on both supply-side changes (donor guidelines) and demand-side education (taste tests and recipes) offers a replicable model for emergency food systems. Similar pantry-based efforts in other regions have echoed these findings, highlighting the value of adapting the NOVA framework to non-commercial food distribution [42]. Leung et al. [43] additionally documented that food-insecure households relying on pantries often have higher baseline UPF intake, underscoring the potential reach of such targeted interventions.

5.3. Behavioural and Educational Interventions

Targeted behavioural programmes complement environmental changes by equipping individuals with practical skills. A pilot randomized trial by Hagerman et al. [44] tested a novel dietary intervention focused explicitly on ultra-processed food reduction and found it feasible and acceptable among adults, with preliminary evidence of lowered UPF intake and modest anthropometric improvements.

Systematic synthesis of such efforts reinforces the pattern. Aramburu et al. [45] reviewed randomized controlled trials of educational and counselling interventions and concluded that advice to limit ultra-processed foods produced benefits for dietary quality and some weight-related outcomes, although effects on metabolic markers were less consistent. Effective programmes typically combined goal-setting, self-monitoring, and practical substitution strategies delivered through group sessions or personalized support [44, 45]. Kaur et al. [46] reported promising results from a school-based behaviour change intervention aimed at reducing UPF consumption among adolescents, further supporting the value of tailored educational approaches in community settings.

5.4. Effectiveness, Challenges, and Lessons from Low- and Middle-Income Settings

Overall, community interventions demonstrate potential to lower ultra-processed food consumption, yet results vary by intensity and duration. While school and pantry programmes show clear environmental impact, behavioural interventions achieve smaller individual-level changes that may accumulate when scaled [44, 45].

Implementation challenges include cost, staff training, and competing commercial pressures, particularly in low- and middle-income countries where ultra-processed foods are aggressively marketed. Brazil's experience with PNAE illustrates how national policy can support local action, but equity remains an issue in reaching the most vulnerable households [39, 40]. Miles [47] highlighted additional barriers in community food assistance programmes, noting that structural factors such as limited cold storage and donor preferences often hinder sustained UPF reduction.

Sustained success appears greatest when interventions address both food availability and cultural preferences. Lessons from Latin American settings emphasize the need for multi-component designs that combine procurement rules, education, and community engagement to achieve lasting dietary shifts [41, 43].

6. Policy Approaches for Prevention

Policy interventions represent the most scalable lever for curbing ultra-processed food consumption at population level. Unlike individual counselling or community programmes, regulatory, fiscal, and procurement measures can reshape food environments, shift industry incentives, and reduce exposure across socioeconomic groups. Real-world implementations in Latin America provide the strongest evidence base, while emerging global frameworks outline comprehensive packages addressing production, marketing, affordability, and supply chains. This section examines key policy instruments, their documented impacts, and the political economy barriers that continue to limit wider adoption.

6.1. Regulatory Instruments: Front-of-Pack Warning Labels and Marketing Restrictions

Mandatory front-of-pack warning labels have emerged as one of the most effective tools for informing consumers and prompting reformulation. Chile's 2016 Law of Food Labelling and Advertising, which introduced black octagonal "high in" labels for sugar, salt, saturated fat, and calories, was accompanied by child-directed marketing bans and school sales restrictions. Taillie et al. [48] evaluated household purchase data before and after implementation and reported significant declines in the volume and nutrient content of labelled products, with effects persisting across income levels.

Mexico followed with its own warning-label system in 2020, using the PAHO nutrient profile model and additional cautions on non-sugar sweeteners and caffeine. Crosbie et al. [49] documented the policy process and early outcomes, noting rapid reformulation by manufacturers and measurable reductions in purchases of high-in products. Similar systems in Colombia, Peru, and Uruguay have reinforced the regional trend, showing consistent consumer responses and industry adaptation [50].

Marketing restrictions, particularly those limiting child exposure, complement labelling. Chile's prohibition of advertising between 06:00 and 22:00 on television, together with bans on cartoon characters and school promotions contributed to the overall package effect observed in purchase data [48]. These combined regulatory approaches demonstrate that warning labels work most powerfully when embedded within broader marketing controls.

6.2. Fiscal Measures and Taxation

Taxes on sugar-sweetened beverages and selected ultra-processed foods offer another proven lever. Colombia's 2023 tax on ultra-processed products, based on both nutrient profiling and processing extent, covers approximately 95 % of the UPF market and has begun to influence purchasing patterns [51]. Earlier SSB taxes in Mexico and Chile produced price elasticities that translated into meaningful consumption reductions, particularly among lower-income households [52].

Modelling studies project that well-designed taxes on ultra-processed foods could generate both health gains and revenue for subsidizing minimally processed alternatives. Popkin et al. [53] reviewed fiscal policies across Latin America and concluded that taxes are most effective when paired with subsidies for fresh produce and clear communication campaigns. Brazil's ongoing health tax reform discussions further illustrate how selective taxation can be integrated into broader fiscal frameworks to protect minimally processed foods while discouraging ultra-processed alternatives [54].

6.3. Supply-Side Policies and Public Procurement

Governments can directly influence supply through procurement standards and retail regulations. Brazil's National School Feeding Programme (PNAE) requires that at least 75 % of funds be spent on fresh or minimally processed foods, effectively capping ultra-processed items in public institutions [55]. Similar procurement rules in other Latin American settings have demonstrated feasibility and positive effects on both child nutrition and local agriculture.

Retail and workplace policies, including restrictions on in-store placement of ultra-processed products, remain less widespread but show promise in pilot evaluations. Global recommendations increasingly call for comprehensive supply-chain measures that address reformulation incentives, availability and affordability simultaneously [56].

6.4. Barriers, Facilitators, and the Political Economy of Reform

Corporate political activity constitutes the primary obstacle to stronger policies. Pereira et al. [57] conducted a scoping review of front-of-pack labelling, marketing restrictions and taxation across multiple countries and found that industry strategies such as lobbying, coalition building, information management and legal challenges accounted for over 63 % of documented barriers. Huse et al. [58] detailed similar tactics in the Philippines, where transnational ultra-processed food corporations engaged policymakers directly and promoted voluntary codes as substitutes for regulation.

Facilitators centre on strong governance, civil-society mobilization, and evidence-based advocacy. Successful Latin American cases highlight the role of independent research, multi-sector coalitions, and transparent conflict-of-interest safeguards in countering industry influence [57, 59]. Oliver and Boaz [60] emphasize that protecting policy space from commercial interference is essential for translating evidence into effective action.

6.5. Impact Evaluations and Global Policy Recommendations

Post-implementation evaluations confirm meaningful population-level effects. Modelling from Mexico estimated that warning labels could avert 1.3 million obesity cases over five years while generating substantial health-care cost savings [61]. Chile's combined policies produced sustained reductions in sugar, sodium, and calorie purchases, with benefits distributed across socioeconomic strata [48].

The 2025 Lancet Series synthesizes these lessons into a comprehensive policy package. Manzini and Accorsi [62] advocate measures across four domains which are products, food environments, manufacturers and supply chains as Baker et al. [60] called for global coordination to confront corporate power and support a just transition toward minimally processed diets. Taken together, the evidence supports shifting from nutrient-focused guidelines to processing-based regulations that address the root drivers of ultra-processed food dominance. The table below presents real-world examples of implemented policy interventions, illustrating their design, outcomes, and supporting evidence from the literatures reviewed.

Table 2 Real-World Policy Interventions for Reducing Ultra-Processed Food Consumption: Design, Outcomes and Evidence

Country / Region	**Policy Instrument**	**Year Implemented**	**Key Features**	**Reported Outcomes**	**Equity Considerations**	**References**
Chile	Warning labels + marketing bans	2016	Black octagonal "high-in" labels + child ad bans	Significant ↓ in purchases of labelled products; reformulation	Benefits across all income levels	Taillie et al. [48]
Mexico	Front-of-pack warning labels	2020	PAHO nutrient profile + sweetener/caffeine warnings	Rapid reformulation; measurable ↓ in high-in product purchases	Stronger effect in lower-income groups	Crosbie et al. [49]
Colombia	Tax on ultra-processed foods	2023	Nutrient + processing-based tax (≈95% UPF coverage)	Early reductions in purchasing patterns	Targeted at high-consumption products	Scrinis et al. [51]
Brazil	National School Feeding Programme (PNAE)	2021	≥75% funds on fresh/minimally processed foods	Shift to unprocessed ingredients; ↓ obesity in adolescents	Supports local agriculture and vulnerable children	de Azevedo et al. [39]; Boklis-Berer et al. [40]
Latin America (multi-country)	Combined labelling + marketing + procurement	2016–2023	Integrated policy packages	Sustained ↓ in sugar, sodium and calorie purchases	Broad socioeconomic benefits	Popkin et al. [50]; Popkin et al. [53]
Mexico (modelling)	Warning labels (scale-up projection)	2023	Hypothetical national implementation	Projected avoidance of 1.3 million obesity cases + cost savings	High potential impact in LMICs	Villaverde et al. [61]
Global (Lancet Series)	Comprehensive policy package	2025	Products, environments, manufacturers, supply chains	Recommended framework for halting UPF rise	Equity-focused transition for LMICs	Scrinis et al. [51]; Baker et al. [54]

LMICs: Low- and Middle-Income Countries, UPF: Ultra-processed foods, '↓': Decrease

7. Conclusion

Ultra-processed foods have emerged as a dominant yet modifiable driver of the global non-communicable disease epidemic. Robust epidemiological evidence, supported by multiple umbrella reviews and large prospective cohorts, consistently links higher consumption to increased risks of obesity, type 2 diabetes, cardiovascular disease, certain cancers, depression, and all-cause mortality. These associations persist after adjustment for overall diet quality and traditional risk factors, while controlled feeding trials confirm that processing itself promotes excess energy intake beyond nutrient composition alone. Mechanistic studies further implicate disrupted satiety signalling, gut microbiome alterations, additive-induced barrier dysfunction, and chronic low-grade inflammation as key pathways. Together, the data underscore that reducing ultra-processed food exposure represents one of the most promising avenues for NCD prevention.

Community interventions have demonstrated that targeted changes in schools, workplaces, and food pantries can meaningfully lower availability and intake, particularly when education and environmental redesign are combined. Real-world examples from Latin America illustrate how national school feeding programmes and pantry-based substitution strategies can shift dietary patterns, especially among vulnerable populations. At the same time, policy instruments such as front-of-pack warning labels, marketing restrictions, selective taxation and public procurement standards have produced measurable reductions in purchases and prompted industry reformulation. These approaches prove most effective when implemented as coherent packages that simultaneously address product formulation, marketing, affordability and supply chains as well.

The evidence therefore calls for a fundamental shift from nutrient-centric dietary guidelines toward processing-based classification systems such as NOVA. Policymakers should prioritize equity, ensuring that low and middle-income countries where ultra-processed food markets are expanding most rapidly are supported in implementing context-appropriate regulations without undue industry interference. Sustained progress will require stronger governance, civil-society engagement and protection of policy space from commercial determinants of health.

Important research gaps actually remain. Longer-term randomized trials, additive-specific mechanistic studies, and rigorous evaluations of combined policy packages are needed to refine implementation strategies and quantify population-level benefits. Nevertheless, the accumulated evidence is sufficiently compelling to justify immediate, multi-level action. By integrating community programmes with bold regulatory and fiscal measures, societies can begin to reverse the rise of ultra-processed foods, promote minimally processed diets, and curb the growing burden of non-communicable diseases worldwide.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors confirm they have no financial interests or personal connections that might have affected the research shared in this paper.

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