

THE IMPACT OF ULTRA-PROCESSED FOODS ON THE GLOBAL OBESITY EPIDEMIC

Marija Dimitrovska^{1*}

¹Zentiva Pharma, Republic of N. Macedonia, e-mail: maria_bt2002@yahoo.com

Abstract: Obesity has become one of the most urgent health concerns worldwide, shaped by a complicated mix of biological, lifestyle, and environmental influences. Among these, the fast rise in intake of ultra-processed foods (UPFs) has attracted increasing scientific scrutiny. UPFs, defined within the NOVA classification system as industrial formulations composed of refined ingredients and additives, are marked by substantial caloric concentration, excessive sugar, salt, and unhealthy fats, and low nutritional quality. This narrative review synthesizes current epidemiological evidence linking UPF consumption with obesity-related outcomes, including increased body mass index, abdominal adiposity, and metabolic dysfunction. Proposed mechanisms include impaired satiety signaling, alterations in gut microbiota, activation of neurobiological reward pathways, and promotion of chronic low-grade inflammation. While observational studies consistently demonstrate positive associations, methodological challenges and controversies—such as confounding lifestyle factors and limitations in dietary assessment—remain unresolved. Nevertheless, the convergence of biological plausibility and epidemiological findings underscores the immediate need for comprehensive public health strategies aimed at reducing UPF intake. Policy interventions including taxation, labeling, marketing restrictions, and product reformulation may represent critical tools in mitigating the global obesity epidemic.

Keywords: *obesity, ultra-processed foods, NOVA classification, public health, food industry*

Field: Medical Sciences

1. INTRODUCTION

Obesity has become one of the most serious global public health concerns of the contemporary era, with continuously increasing prevalence affecting individuals regardless of age or socioeconomic status. Characterized by exaggerated concentration of adipose tissue that may impair health, obesity is strongly connected with a wide range of chronic conditions, including type 2 diabetes mellitus, cardiovascular disease, hypertension, dyslipidemia, certain malignancies, and musculoskeletal disorders. Beyond its clinical consequences, obesity imposes substantial economic and social burdens on healthcare systems worldwide through elevated healthcare costs, diminished productivity, and erosion of life standards.

Over recent decades, profound transformations in global food systems and dietary behaviors have occurred because of urbanization, industrialization, economic development, and globalization. Conventional eating habits based predominantly on fresh and minimally processed foods have increasingly been replaced by highly industrialized food products that are convenient, inexpensive, aggressively marketed, and widely accessible. These changes have coincided temporally with the rapid escalation of obesity rates observed worldwide, suggesting that modern dietary environments may play a critical role in obesity development.

Within this context, increasing scientific attention has focused on ultra-processed foods (UPFs), a category established through the NOVA food classification system. UPFs are industrial formulations manufactured primarily from refined substances derived from foods, chemically altered ingredients, and cosmetic additives intended to improve palatability, appearance, shelf life, and convenience. Common examples include sugar-sweetened beverages, packaged snacks, fast foods, processed meats, instant meals, and sweetened breakfast cereals. These products are typically defined by high-power density, excessive amounts of sugar, salt, and unhealthy fats, as well as low fiber and micronutrient content.

Growing proof indicates that excessive UPF consumption may contribute significantly to obesity and metabolic dysfunction through numerous biological and behavioral mechanisms. Proposed pathways include increased caloric intake due to hyper-palatability, impaired satiety signaling, alterations in gut microbiota, inflammatory responses, hormonal dysregulation, and activation of neurobiological reward systems. Furthermore, epidemiological studies conducted across diverse populations have consistently demonstrated associations between high UPF consumption and increased body mass index (BMI), abdominal obesity, and long-term weight gain.

Regardless of the cumulative research supporting this relationship, important controversies and methodological challenges remain unresolved. Questions persist regarding the independent role of food

*Corresponding author: maria_bt2002@yahoo.com



processing relative to nutrient composition, limitations of dietary assessment methods, and potential confounding lifestyle factors influencing observed associations. Consequently, comprehensive evaluation of current evidence is necessary to enhance comprehension of the contribution of UPFs to the global obesity epidemic.

This review aims to critically investigate the connection between ultra-processed food intake and obesity by summarizing current epidemiological evidence, exploring underlying biological mechanisms, and discussing broader public health implications and future research directions.

2. MATERIALS AND METHODS

A narrative literature review was conducted to evaluate current scientific evidence regarding the correlation between ultra-processed food dietary intake and obesity. Relevant articles were identified through electronic database searches performed using PubMed, Scopus, Web of Science, and Google Scholar.

The search methodology included fusion of the following keywords and Medical Subject Headings (MeSH) terms: “ultra-processed foods,” “obesity,” “NOVA classification,” “body mass index,” “metabolic syndrome,” “dietary patterns,” “food processing,” and “weight gain.” Priority was given to studies published between 2010 and 2025 in peer-reviewed scientific journals.

Eligible sources included systematic reviews, randomized controlled trials meta-analyses, cross-sectional studies, cohort studies, and major policy or consensus reports addressing the relationship between UPFs and obesity-related outcomes. Additional related references were determined through manual inspection of bibliographies from selected publications.

Studies focusing primarily on unrelated dietary exposures or lacking clear relevance to obesity outcomes were excluded. Preference was given to high-quality studies involving large population samples and standardized dietary assessment methodologies. The collected literature was analyzed and synthesized thematically, with particular emphasis placed on definitions and classification of ultra-processed foods, epidemiological evidence, biological mechanisms linking UPFs and obesity, and public health implications.

3. RESULTS

3.1. Ultra-Processed Foods: Definition and Classification

The categorization of foods based on the degree and purpose of industrial processing has emerged as an important framework in nutritional epidemiology. Among the most widely used systems is the NOVA classification, which classifies foods into four groups according to the degree of processing involved in their production. These categories include unprocessed or minimally processed foods, processed culinary ingredients, processed foods, and ultra-processed foods.

Ultra-processed foods represent the most industrially modified category within the NOVA system. They are typically manufactured using food-extracted or food-derived compounds, including refined starches, sugars, oils, protein isolates, and hydrogenated fats, combined with additives such as emulsifying agents, colorants, flavor boosters, sweeteners, and preservatives. In contrast to minimally processed foods, UPFs generally contain few intact whole-food components and are designed primarily for convenience, extended shelf life, and enhanced sensory appeal.

Examples of UPFs include carbonated soft drinks, packaged confectionery products, sweetened breakfast cereals, instant soups, fast foods, processed meat products, industrial bakery items, and ready-to-eat frozen meals. These products frequently possess high energy density while containing excessive levels of added sugars, sodium, and saturated or trans fats. Simultaneously, they are often deficient in dietary fiber, vitamins, minerals, and other health-promoting bioactive compounds naturally found in whole foods.

One of the hallmark features of UPFs is hyper-palatability, which is achieved through specific combinations of sugar, fat, salt, and artificial flavorings that stimulate reward pathways and encourage overconsumption. Additionally, the aggressive marketing strategies employed by multinational food corporations, particularly those targeting children and adolescents, further contribute to widespread consumption patterns.

The increasing dominance of UPFs within modern dietary environments has paralleled major changes in global nutritional habits. In numerous high-income countries, UPFs account for more than half of total daily caloric intake, while rapidly rising consumption has also been documented in middle-income and developing nations undergoing nutritional transition. These trends have raised substantial concerns

regarding the potential contribution of UPFs to obesity and related noncommunicable diseases.

Although the NOVA classification system has gained considerable acknowledgment within nutritional research, it has also been subject to criticism. Some researchers dispute that classification may oversimplify complex relationships between food processing and health outcomes by grouping nutritionally diverse products within the same category. Nevertheless, the NOVA framework remains highly influential in contemporary research investigating the health effects of industrial food processing.

3.2. Global consumption trends of UPFs

Consumption of UPFs has increased dramatically across affluent and developing nations over recent decades. In several Western nations, daily dietary consumption is characterized by over 50% reliance on UPFs. Similar trends are increasingly observed in developing economies undergoing nutritional transition, where traditional dietary habits are progressively replaced by industrialized food products. Socioeconomic disparities also appear to influence UPF consumption patterns. Lower-income populations may rely more heavily on inexpensive ultra-processed products due to affordability, accessibility, and limited availability of healthier alternatives.

3.3. Biological mechanisms linking UPFs and obesity

The following biological mechanism links UPFs and obesity:

a. Energy density and satiety- Ultra-processed foods are typically represented by high energy density and low satiety potential. Their soft texture, rapid oral processing, and high glycemic load may impair normal appetite regulation mechanisms, resulting in increased caloric consumption before satiety signals are activated.

b. Gut microbiota- emerging evidence indicates that eating habits rich in UPFs may adversely alter gut microbiota composition and diversity. Food additives such as emulsifying agents and artificial sweeteners have been associated with intestinal dysbiosis, increased gut permeability, and chronic low-grade inflammation, and all of these may contribute to obesity pathogenesis.

c. Neurobiological reward system- several studies suggest that hyper-palatable UPFs stimulate dopaminergic reward pathways in a manner comparable to addictive substances. Repeated exposure may reinforce compulsive eating behaviors and diminish sensitivity to natural satiety mechanisms.

3.4. Epidemiological evidence

Numerous observational studies have persistently manifested a positive correlation between UPF consumption and obesity-related consequences. Large prospective cohort studies indicate that people with the highest UPF consumption exhibit significantly greater risks of weight gain, abdominal obesity, and metabolic syndrome compared with populations consuming minimally processed diets. Although most epidemiological findings support this association, several limitations should be acknowledged, including reliance on self-reported dietary assessments and heterogeneity in food classification methodologies.

3.5. Public health implications

The widespread availability and aggressive marketing of UPFs represent substantial challenges for public health systems worldwide. Given the strong association between obesity and noncommunicable diseases, reducing UPF consumption may constitute an important strategy for mitigating healthcare burden and associated economic costs. Policy interventions including front-of-package labeling, taxation of sugar-sweetened drinks, constraints on food marketing directed toward children, and reformulation initiatives have demonstrated varying degrees of effectiveness in reducing unhealthy dietary behaviors.

3.6. Challenges and controversies

Despite growing evidence linking UPFs to obesity, several controversies remain unresolved. Critics of the NOVA classification system argue that food processing itself may not necessarily determine health outcomes independently of nutrient composition. Furthermore, observational studies cannot fully exclude residual perplexing factors such as physical training, socioeconomic status, and overall dietary quality.

3.7. Future perspectives

Future research should emphasize long-term randomized controlled studies capable of establishing causal relationships between UPF consumption and obesity development. Additionally, greater standardization of dietary assessment tools and food classification systems is required to improve comparability across studies.

4. DISCUSSIONS

The findings of this review reinforce the growing consensus that ultra-processed foods play a significant role in the global obesity epidemic. The convergence of epidemiological evidence and mechanistic insights suggests that UPFs contribute to excessive caloric intake, metabolic dysregulation, and long-term weight gain. Their hyper-palatability, affordability, and aggressive marketing—particularly toward susceptible groups, including children and economically disadvantaged populations, create powerful drivers of overconsumption.

At the same time, controversies surrounding the NOVA classification system highlight the complexity of disentangling the effects of food processing from nutrient composition. Some critics argue that not all UPFs are equally detrimental, and that reformulation strategies may mitigate health risks without requiring complete elimination. Furthermore, reliance on self-reported dietary data introduces measurement error, and residual bewildering factors such as physical training and socioeconomic rank complicate causal inference.

Despite these challenges, the public health implications are profound. With UPFs accounting for more than half of daily caloric intake in many high-income countries—and rapidly increasing in middle-income nations, the burden on healthcare systems is escalating. Policy measures such as front-of-package labeling, sugar-sweetened beverage taxation, restrictions on child-targeted advertising, and incentives for reformulation have shown promise but require broader implementation and evaluation.

Importantly, interventions must also consider cultural, economic, and social dimensions of food choice to ensure equitable access to healthier alternatives. Addressing the dominance of UPFs in modern diets will require coordinated action across governments, industry, and civil society to reshape food environments and promote sustainable, health-supportive dietary patterns.

5. CONCLUSIONS

In conclusion, the accumulated body of evidence strongly supports a strong correlation between ultra-processed food (UPF) ingestion and the global obesity epidemic. This relationship is underpinned by multiple biological, behavioral, and socioeconomic mechanisms, including impaired satiety signaling, alterations in gut microbiota, activation of neurobiological reward pathways, and the pervasive influence of aggressive marketing strategies. Together, these factors contribute to excessive caloric intake, metabolic dysfunction, and long-term weight gain across diverse populations.

The increasing worldwide dependence on industrially processed foods reflects profound transformations in global food systems, driven by urbanization, economic development, and globalization. While UPFs provide convenience and affordability, their dominance in modern diets has coincided with escalating rates of obesity and related noncommunicable diseases. This trend imposes substantial burdens on healthcare systems, economies, and societies, underscoring the urgency of coordinated preventive action.

At the same time, ongoing controversies—such as the debate over the NOVA classification system and the challenge of disentangling the effects of food processing from nutrient composition—highlight the need for methodological refinement and more robust causal evidence. Focus of future exploration should be on long-term randomized controlled studies to establish causality, alongside improved dietary assessment methodologies and standardized classification systems.

From a public health perspective, reducing UPF consumption must be recognized as a critical strategy in obesity prevention. Policy measures such as front-of-package labeling, taxation of sugar-sweetened beverages, restrictions on child-targeted advertising, and product reformulation initiatives have demonstrated promise but require broader implementation and rigorous evaluation. Importantly, interventions must also address socioeconomic disparities by ensuring equitable access to healthier, minimally processed alternatives.

Ultimately, tackling the global obesity epidemic will require a multifaceted approach that integrates scientific evidence, policy innovation, and societal engagement. By reshaping food environments and promoting sustainable dietary patterns, governments, industry, and civil society can collectively address the health consequences related to UPFs and foster a healthier future for populations worldwide.

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