A study on Ultra-Processed Foods and Cancer Risk: A Comprehensive Review

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Abstract

According to the NOVA hierarchy for processed foods, ultra processed foods (UPFs), are now a major part of the diet globally. With increased UPF consumption, there are now concerns about how UPFs impact the risk of developing chronic diseases such as cancer. The aim of this review is to analyse and summarise the epidemiological, biological and public health evidence, looking at the association between UPF consumption and the risk of developing cancer. A large number of sources were reviewed, including cohort studies, systematic reviews, meta analyses, RCTs and mechanistic studies published from 2018 - 2025. Databases used for sourcing information included Google Scholar, PubMed and ScienceDirect. From the evidence of large prospectively studied cohorts, there is a clear positive association between high consumption of UPF and an increased risk for all types of cancers, along with colorectal, breast and ovarian cancers. There are several biological mechanisms by which this association may be explained including metabolic dysfunction related to obesity, chronic diseases associated with obesity and fat accumulation, chronic exposure to food additives and chemical contaminants from food environments including the materials used in food packaging, the formation of newly formed toxic compounds, and alterations in gut microbiota (1-7). Although the relative effect sizes may be moderate, widespread UPF consumption suggests there are significant public health implications for the population as a whole. The findings of this review indicate that more longitudinal and biological research of how UPF consumption may increase the risk for developing cancers is needed.

Keywords: UPFs, NOVA classification, cancer, epidemiology, mechanistic, public health.

1. Introduction

1.1 Background

One of the greatest changes in global diets has come with the growth of the manufacturing, processing, and distribution of food products. The introduction and use of ultra-processed foods (UPFs), which are food products made from different combinations of foods and contain additives, flavour enhancers, hydrogenated fats, preservatives, stabilisers and highly refined food components, is increasing. Research results show that UPFs account for an average of approximately:

• 50-60% of daily calorie consumption in the US

• 50% in the UK

• 45% in Canada

• 25-35% in parts of Latin America and Asia

This rise in UPF consumption coincides with an increase in obesity, diabetes, cardiovascular disease and various cancers related to diet. Earlier research has focused largely on the nutrient profile of ultra-processed foods i.e. high fat, sugar and sodium content. However, more recent evidence suggests that the process of the food may also independently affect health outcomes in humans, in addition to specific nutrients, due to the multiple forms of processing (physical, chemical, biological) UPFs undergo.

1.2 Why Research UPFs and Cancer?

Cancer continues to be a top cause of morbidity and mortality worldwide, and the dietary component of cancer is estimated to account for 25-30% of cases of cancer. Interest in UPFs has been driven by:

1. The emergence of epidemiologic studies linking UPFs to cancer among diverse groups of people

2. The mechanistic plausibility of UPFs containing additives, packaging contaminants, and/or neo-formed food elements

3. The potential impact of UPFs on obesity, inflammatory conditions, and disruptions to metabolic pathways

4. The variability of exposure to UPFs as a result of geographic locale and lifestyle choices

2. The NOVA Classification System

2.1 General Information about NOVA

The NOVA classification system organises food based on levels of industrial processing:

1. Unprocessed/minimally processed foods

2. Culinary processed foods

3. Processed foods

4. Ultra-Processed Foods (UPF)

2.2 Characteristics that Define UPFs

UPFs are characterised by the following criteria:

• Contain five or more industrial processed ingredients

• Possess chemical or non-nutritive additives (e.g., preservatives, flavourings, colours, sweeteners, emulsifiers)

• Produced using processes such as extrusion, hydrogenation, moulding, or carbonation

• Designed to be hyperpalatable

• Have low satiety for the calories they contain

Examples: Crisps, soft drinks, instant noodles, frozen meals, sweet breakfast cereals, processed meats and energy drinks.

2.3 Relevance of Cancer Research to NOVA

This new classification system enables researchers to examine the following:

• The chemical changes that occur during processing,

• The exposure to food additives that may be missed in general dietary assessments,

• The degree of risk of developing cancer from consuming foods made from industrial processed ingredients.

3. Review Methodology

This review used a narrative literature review (NLR) format to provide an overview of the evidence regarding the link between ultra-processed foods (UPF) and the risk of developing cancer. The search for articles to include in the NLR was done through electronic databases: Google Scholar, PubMed and ScienceDirect, and by various combinations of search terms. The search focus was on articles published between 2018 and 2025 in order to have the most up-to-date evidence.

Included in the NLR were prospective cohort studies, systematic reviews, meta-analyses, and randomized controlled trials analysing metabolic effects, animal studies, mechanistic studies (e.g., in vitro studies), studies of the microbiome and toxicology), and reports describing regulatory/policy-related or institutionally-mandated data. Studies were only included if they defined UPFs as demonstrated in established classification systems (mainly NOVA), investigated the impact of UPFs on cancer, adjusted for major confounders and were published in a peer-reviewed journal. Studies which did not provide definitions of exposure and/or lacked methodological quality were excluded as invalid. Results derived from the included studies were synthesised qualitatively with the aim of elucidating common themes in the research, as well as investigating mechanisms by which UPF might lead to an increased incidence of cancer and where there are gaps in current research.

Table 1: Key Epidemiological Studies

Author (Year)	Population / Sample	UPF Definition	Cancer Type	Effect Size / HR	Notes
Fiolet et al., 2018	NutriNet-Santé, France (105,000+)	NOVA	Total cancer	HR 1.12 per 10% increase	Adjusted for BMI, age, SES
Zhang et al., 2023	US adults (50,000+)	NOVA	Colorectal	HR 1.25 highest vs lowest	Men slightly higher risk
Ferreira et al., 2024	Cohort + mechanistic	UPF	Multiple	–	Emulsifiers, microbiome mechanisms
Bonaccio et al., 2021	Moli-Sani, Italy	UPF via FFQ	Overall mortality & cancer	RR 1.10	Large prospective cohort
Srour et al., 2019	NutriNet-Santé, France	NOVA	Cardiovascular & cancer	HR 1.15	Metabolic focus, indirect cancer risk

4. Epidemiological Evidence

4.1 Overall Cancer Incidence

Prospective cohort studies have repeatedly demonstrated a strong relationship between the amount of ultra-processed food eaten and overall cancer incidence. Specifically, for every 10% increase in ultra-processed food consumption, there is an accompanying increase of 10%-12% in the risk of being diagnosed with any type of cancer. The association is found to be independent of several potential confounding factors, including body mass index (BMI), physical activity levels, and socioeconomic status.

4.2 Colorectal Cancer

Ultraproduced foods (ie: processed meats, sweetened beverages, and pre-cooked/meals) are thought to be linked to colorectal cancers (CRCs) due to the higher prevalence of CRC among men vs women. Odds ratios of being diagnosed with CRC have been reported to be 1.15-1.35 for individuals who consume high ultra-processed vs those who consume low ultra-processed quantities.

Mechanisms for CRC

• Exposure to salt and emulsifiers present on colonic mucosa

• Disruption of gut microbiome

• Nitrosamines (cancer-causing compounds formed during the processing of meat) formed during the dietary processing of ultra-processed foods

• Chronic inflammatory responses to ultra-processed foods

4.3 Breast Cancer

There is moderate epidemiological evidence that high ultraprocessed food consumption may increase risk for breast cancer, particularly among premenopausal females. The potential for excessive ultra-processed food consumption to disrupt hormonal balance, increase inflammatory responses, and promote weight gain is thought to contribute to this increased risk. Depending on the specific study reviewed, the reported hazard ratio of breast cancer among individuals who consume ultra-processed versus non-ultra-processed foods has been reported to be between 1.10-1.25.

4.4 Ovarian Cancer

Recent pooled analyses indicate that female consumers of high amounts of ultra-processed foods have a 20% to 30% higher incidence of developing ovarian cancer than women who do not regularly consume high ultra-processed foods. The increased risk may be related to the presence of endocrine disruptor chemicals in the packaging of ultra-processed foods, such as bisphenol-A (BPA) and phthalates.

4.5 Other Cancers

There is limited and inconclusive evidence regarding the association between ultra-processed foods and pancreatic, endometrial, liver, and prostate cancer. No significant association has been reported for hematological cancers.

5. Mechanistic Pathways

5.1 Obesity/Miscellaneous Metabolic Dysregulation UPF consumption contributes to increased caloric intake, leading to obesity and an increased risk of at least 13 different cancers, as described by hyperpalatability, lower satiety value, high glycemic index/load, and promoting insulin resistance.

5.2 Food Additives & Chemicals Emulsifiers break down the gut barrier, promote chronic gut inflammation, and induce tumors in animal studies. Artificial sweeteners may have effects on insulin levels, gut bacteria composition, or metabolite production and may have genotoxic potential; however, current data are inconsistent.

5.3 Newly Formed Chemicals Some methods of food production produce acrylamide, heterocyclic amines, AGEs, and PAHs, which can contribute to DNA damage and oxidative stress.

5.4 Chemicals Introduced Via Packaging BPA, phthalates, and microplastics may affect hormone signaling and have the potential to create oxidative stress, both of which may increase the risk of hormone-dependent cancers.
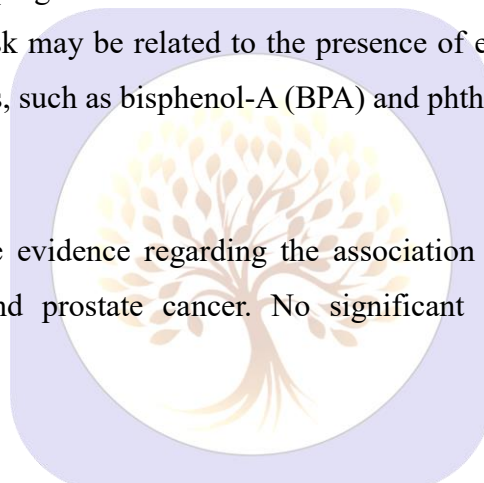
5.5 Changes in the Gut Microbiota Consumption of a diet high in UPFs leads to decreased levels of soluble fibre and resistant starch and, as a result, results in altered gut microbiota, decreased production of short-chain fatty acids, increased gut permeability and chronic inflammation.

6. Limitations

• There are confounding and reverse causation issues related to factors like the Socioeconomic Status (SES), smoking habits, physical inactivity, and the types of food people eat.

• There are challenges using NOVA classifications for classifying foods. Culture plays a part here and there are many borderline foods.

• Assessing diets using Food Frequency Questionnaire's (FFQs) and 24 hour recalls can lead to misclassifications.

• There is uncertainty about dose-response relationship between childhood and lifetime exposure since it's not fully understood.

• Studies that address the varieties of people across a population are limited, especially in non-Western populations.

## 7. Policy, Regulatory, and Clinical Implications

7.1 Policy Recommendations

• Label warning systems in countries like Chile and Mexico

• Restrict advertising

• Front of package processing information

• Tax sugary drinks and UPFs

• Set school meal guidelines that limit UPFs from being served to children

7.2 Clinical Practice - Reduce UPF consumption - Promote the use of whole and minimally processed foods - Maintain a healthy body weight - Decrease intake of processed meats and sugary drinks.

7.3 Public Health Significance- Even a slight risk to an individual may have a significant impact as a whole population because there are so many people consuming UPFs and were exposed to UPFs at a young age.

8. Research Opportunities

1. Identify the biomarkers related to UPF exposure (additives, chemicals from packaging)

2. Conduct longitudinal studies to track human development from childhood to adulthood

3. Determine the specific biochemical pathways linking UPFs to cancer

4. Test whether reducing UPF consumption lowers cancer risk through placebo-controlled trials
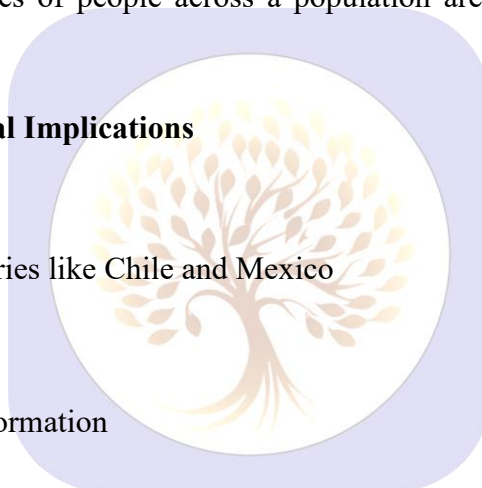
5. Establish whether 'reformulated' UPFs marketed as having healthier attributes are actually healthier for consumers

6. Compare and contrast between cultures (i.e., Asia, Africa and Latin America)

9. Conclusion

It appears from the current body of evidence that high UPF consumption is correlated with increased colorectal and ovarian cancer risk; however, effect sizes are relatively small compared to what we see regarding cancers associated with tobacco smoke exposure or UV radiation. Nevertheless, these findings show public health implications and should be included as part of cancer prevention strategies at the population level. Future studies should better delineate and quantify the mechanisms by which UPFs influence cancer risk and develop a method for better quantifying the extent of UPF consumption. Additionally, the results of additional research will help to create better methods for regulating UPFs.

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