International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 03-02-2025, Accepted: 05-03-2025, Published: 21-03-2025
Volume 10, Issue 2, 2025, Page No. 36-40

Beyond the label: Uncovering the ultra-processed foods and its impact on public health

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Abstract
In recent decades, the consumption of ultra-processed foods has increased globally. Ultra-processed foods (UPF) are typically ready-to-eat or ready-to-heat food products, primarily composed of ingredients derived from whole foods that have undergone extensive industrial processing. These foods are highly palatable and convenient. But, their nutritional profile often lacks essential micronutrients and fibre. Ultra-processing encompasses multiple steps focused on converting raw ingredients into extensively processed food items. The components utilised in ultra-processed foods are pivotal, contributing to numerous detrimental health effects. Consuming ultra-processed foods has been linked to various health concerns like obesity, depression, type 2 diabetes, cardiovascular disease and cancer. Therefore, promoting greater awareness of the nutritional quality of foods and reducing the intake of ultra- processed foods is crucial for supporting optimal health and mitigating the prevalence of lifestyle diseases globally.

Keywords: Ultra-processed foods, NOVA system, chronic diseases

Introduction
Ultra-processed food consumption has increased globally and has become a major concern in modern diets. These products typically undergo extensive industrial processing, often containing chemical additives, preservatives, and other artificial substances. Studies suggest a link between higher consumption of ultra-processed foods and various health issues, including obesity, heart disease, and metabolic disorders. Furthermore, these foods often lack essential nutrients and fibre while being high in unhealthy fats, sugars, and salt. Thus, reducing the intake of ultra-processed foods and opting for whole, minimally processed alternatives can significantly benefit overall health and well-being.

Ultra-processed foods: Definition
Ultra-processed foods (UPF) are typically ready-to-eat or ready-to-heat food products, primarily composed of ingredients derived from whole foods that have undergone extensive industrial processing (Monteiro *et al*., 2010) [12].

Classification of food processing system
The NOVA system classifies foods into 4 groups according to the nature, extent, and purpose of industrial food processing used in their production (Braesco *et al*., 2022) [1]. These includes;

- Unprocessed/minimally processed foods are defined as parts of plants or animals that have not been industrially processed or have been altered in ways that do not add any new substance (such as fats, sugar, or salt) but may involve removal of parts of the food. Examples include fruits or vegetables, fresh or frozen meat, eggs, milk, and rice or other grains.
- Processed culinary ingredients are substances extracted from unprocessed foods, such as oil and sugar, or obtained from nature, such as salt. Culinary ingredients are typically not consumed alone but are used in combination with unprocessed and minimally processed foods in cooking to make dishes and meals.
- Processed foods are produced by adding salt, oil, sugar, or other culinary ingredients to minimally processed foods. Processed foods remain recognizable as modified versions of unprocessed foods and include items such as canned fruits or vegetables, salted nuts, cured or smoked meats.
- Ultra-processed foods are defined as multi-ingredient industrial formulations and include sugar sweetened beverages, packaged breads, cookies, savory snacks, candy, ice cream, breakfast cereal, and pre-prepared frozen meals.

Processed Vs. ultra-processed foods
The main difference between processed and ultra-processed foods lies in the extent of their processing and the types of ingredients they contain:

- **Based on processing level**

Processed Foods: These foods undergo some level of processing, which may involve cooking, freezing, drying, or packaging to extend shelf life or enhance flavor. Processing may also involve adding salt, sugar, or other preservatives. Examples include canned vegetables, cheese, and freshly baked bread.

Ultra-processed foods: This category represents foods that have undergone extensive industrial processing, often involving multiple steps and the addition of numerous

additives, preservatives, and artificial ingredients. Ultra-processed foods typically bear little resemblance to their original form and may contain ingredients not commonly found in home kitchens. Examples include packaged snacks, sugary drinks, frozen meals, and fast food.

- **Based on ingredients**

Processed foods: Ingredients in processed foods may include natural substances like salt, sugar, and oils, as well as added preservatives, flavorings, and colorings. However, they generally contain recognizable food items and are not heavily reliant on artificial additives.

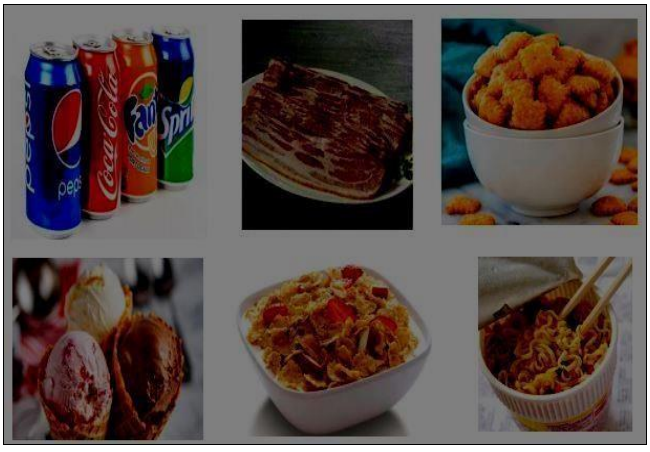
Ultra-processed foods: Ultra-processed foods often contain a long list of ingredients, including artificial flavors, colors, sweeteners, stabilizers, and emulsifiers. These ingredients may be added to enhance taste, texture, appearance, and shelf life, but they contribute little to the nutritional value of the food.

- **Based on nutritional value**

Processed foods: While processed foods may still retain some nutritional value, especially if they are made from whole or minimally processed ingredients, they can vary widely in terms of their nutritional quality. Some processed foods may be rich in nutrients like vitamins, minerals, and fiber, while others may be high in unhealthy fats, sugars, or sodium.

Ultra-processed foods: Ultra-processed foods are often low in essential nutrients and high in unhealthy ingredients like refined sugars, unhealthy fats, and sodium. They tend to be energy-dense but nutrient-poor, contributing to excess calorie consumption without providing the necessary vitamins, minerals, and other beneficial compounds (Elizabeth *et al*., 2020) [4].

Commercially available ultra- processed foods



Ultra-processed foods are typically those that have undergone extensive processing, often containing additives like preservatives, flavorings, and other chemicals (Gupta *et al*., 2019) [8]. They're often convenient but not always the healthiest choice. Common examples include:

- **Soft drinks / energy drinks / ready-to-drink beverages:** They often contain high fructose corn syrup (HFCS), sucralose, saccharin, aspartame and artificial colours.
- **Breakfast Cereals:** Many breakfast cereals are highly processed and lacking in nutritional value. They contain mostly of refined grains, artificial flavours, hydrogenated and trans fat, artificial sweeteners and stabilizers.
- **Ready-to-eat meals:** These often contain high levels of sodium, preservatives, artificial flavours, colourants, emulsifiers, anti-caking agents, hydrogenated and trans fat to maintain taste and texture.
- **Extruded snack foods:** Chips, crackers, and other snacks often contain artificial flavours, colours, stabilizers, emulsifiers, defoaming agents and preservatives.
- **Candy and Sweets:** These are often made with refined sugars, artificial flavours, and colours.
- **Frozen desserts:** They mostly include artificial sweeteners, stabilisers, emulsifiers, flavouring agents, artificial colours and hydrogenated fats.
- **Ultra-processed meat products:** Hot dogs, sausages, and deli meats often contain high levels of sodium, preservatives, hydrogenated and trans fat, sodium nitrite and other additives.
- **Instant Noodles and Soups:** These often contain high levels of sodium, monosodium glutamate (MSG), and other additives to enhance flavour and prolong shelf life. Although it is usually necessary to consume these foods in moderation, their low nutritional content and possible health hazards when consumed in excess should prevented.

Ultra-processing: Increased risk of chronic diseases

Ultra-processed food has impacted the overall nutritional quality of populations globally. Its consumption rate has been increasing in both developed and developing countries. Inevitably, these ultra-processed foods have been linked to a number of health problems including like obesity, depression, type 2 diabetes, cardiovascular disease and cancer.

1. Obesity

Epidemiologic evidence supports a positive association between ultra-processed food (UPF) consumption and body mass index. They often contain high amounts of calories in small serving sizes. Consuming these foods can lead to an excessive calorie intake without providing sufficient satiety, contributing to weight gain. Many ultra-processed foods are loaded with added sugars and are low in dietary fiber, which not only contribute to excess calorie intake but also spike blood sugar levels, leading to insulin resistance and fat storage. A lack of fiber can lead to overeating and weight gain. These foods often contain unhealthy fats such as trans fats and saturated fats, which are linked to obesity and other health problems when consumed excessively. Ultra-processed foods may disrupt the body's natural appetite regulation mechanisms, leading to increased cravings and overconsumption of food. They are heavily marketed and advertised, especially to children and adolescents (Lustig 2020) [11]. This can influence food preferences and consumption patterns, leading to higher intake of unhealthy foods.

2. Depression

Ultra-processed foods often lack essential nutrients such as omega-3 fatty acids and antioxidants, which are important for brain health. Deficiencies in these nutrients have been associated with an increased risk of depression and other mental disorders. This eventually led to inflammation and oxidative stress in the brain, which may contribute to the development of depression and anxiety. A higher percentage of daily energy consumption of ultra-processed foods was associated with cognitive decline among adults (Goncalves *et al*., 2023) [7]. These foods contain high levels of inflammatory ingredients such as refined sugars, unhealthy fats, and additives. Chronic inflammation has been linked to depression, as it can negatively impact neurotransmitter function and brain health. Ultra-processed foods may also disrupt the balance of gut bacteria, leading to inflammation and affecting neurotransmitter production, which can influence mood and contribute to depression. These foods with high levels of refined carbohydrates can cause rapid spikes and crashes in blood sugar levels, which may negatively affect mood and energy levels. Chronic blood sugar dysregulation has been linked to an increased risk of depression. Some additives found in ultra-processed foods, such as artificial sweeteners and preservatives, may disrupt hormonal balance in the body, which can affect mood regulation and increase the risk of depression. Samuthpongtorn *et al*. (2023) [15] found that higher ultra-processed food intake, particularly artificial sweeteners and sweetened beverages was strongly associated with an increased risk of depression among adult females.

3. Diabetes

Ultra-processed foods have been linked to an increased risk of type 2 diabetes. They often contain refined carbohydrates that have a high glycemic index, causing rapid spikes in blood sugar levels. Chronic consumption of these foods can lead to insulin resistance, a key factor in the development of type 2 diabetes. Overconsumption of added sugars has been linked to insulin resistance, impaired glucose tolerance, and an increased risk of type 2 diabetes. These foods often contain unhealthy fats such as trans fats and saturated fats, which have been associated with insulin resistance and inflammation, both of which are risk factors for type 2 diabetes. They are typically low in dietary fiber, which plays a crucial role in regulating blood sugar levels and promoting insulin sensitivity. A lack of fiber in the diet can contribute to unstable blood sugar levels and increase the risk of diabetes. Risk of type 2 diabetes was increased by 37 per cent with an absolute 10 per cent increase in UPF intake (Moradi *et al*., 2021) [14]. An increased risk of gestational diabetes mellitus by 10 per cent in women aged ≥30 years had doubled the risk on consumption of UPF (Leone *et al*., 2021) [9]. Chen *et al*. (2023) [1] observed that an increased risk of type 2 diabetes was associated with greater intake of animal-based processed foods and ready-to- eat mixed dishes.

4. Cardio-metabolic diseases

Ultra-processed foods have been strongly associated with an increased risk of cardio- metabolic diseases, which include cardiovascular diseases (such as heart disease and stroke) and metabolic disorders (such as type 2 diabetes and metabolic syndrome). Ultra-processed foods often contain large amounts of added sugars and refined carbohydrates, which can lead to elevated blood sugar levels and insulin resistance. Over time, this can increase the risk of type 2 diabetes and metabolic syndrome. These foods are high in unhealthy fats, including trans fats and saturated fats, which can raise levels of LDL cholesterol (the "bad" cholesterol) and increase the risk of atherosclerosis (the build-up of plaque in the arteries), leading to heart disease and stroke. They are often loaded with sodium, which can contribute to high blood pressure (hypertension). Chronic hypertension is a major risk factor for cardiovascular diseases such as heart attack and stroke (Lordan *et al*., 2018) [10]. These foods tend to be low in essential nutrients such as vitamins, minerals, and antioxidants. A diet lacking in these nutrients can increase the risk of inflammation, oxidative stress, and other factors that contribute to cardio-metabolic diseases. Excess body fat, particularly visceral fat, can contribute to insulin resistance, hypertension, dyslipidemia, and other metabolic abnormalities (Mambrini *et al*., 2023) [12].

5. Cancer

The relationship between ultra-processed foods and cancer is a topic of ongoing research, and while no direct causative link has been established, there are several mechanisms through which the consumption of ultra-processed foods may potentially increase the risk of cancer. Some of these additives have been linked to adverse health effects and may have carcinogenic properties. For example, nitrites and nitrates, commonly used as preservatives in processed meats, have been associated with an increased risk of certain cancers, particularly colorectal cancer. Chronic consumption of high-sugar foods may contribute to the development of obesity- related cancers, such as breast, colorectal, pancreatic, and endometrial cancer. They are often low in essential nutrients such as vitamins, minerals, and antioxidants, which play important roles in protecting against cancer. A diet lacking in these nutrients may weaken the body's natural defenses against cancer and increase susceptibility to the disease. A 10 per cent increase in ultra- processed foods in the diet was associated with a significant increase of greater than 10 per cent risks of breast cancer (Fiolet *et al*., 2018) [5]. While more

research is needed to fully understand the relationship between ultra- processed foods and cancer, adopting a diet rich in whole, minimally processed foods and limiting the consumption of ultra-processed foods may help reduce the risk of cancer and promote overall health. Additionally, maintaining a healthy weight, engaging in regular physical activity, and avoiding tobacco use are important lifestyle factors for cancer prevention. Cordova *et al*. (2023) [3] found that higher consumption of these foods increases the risk of cancer and cardio- metabolic multimorbidity among women (39%) especially due to the overconsumption of animal-based processed foods and sugar- sweetened beverages.

6. Dermatological problems

Many ultra-processed foods, particularly those high in refined carbohydrates like white bread, sugary snacks, and sweetened beverages, have a high glycemic index. These foods can cause rapid spikes in blood sugar levels, leading to increased insulin production. Elevated insulin levels may stimulate the production of androgens, hormones that can increase oil production in the skin, potentially leading to acne breakouts. Deficiencies in nutrients like vitamin A, vitamin C, vitamin E, zinc, and omega-3 fatty acids can impair skin health and contribute to various skin problems. They can also promote inflammation in the body. Chronic inflammation is associated with various skin conditions, including acne, eczema, psoriasis, and rosacea. Diets high in ultra-processed foods may disrupt the balance of gut bacteria, leading to dysbiosis. Excess sodium intake may exacerbate puffy eyes and worsen the appearance of cellulite. To promote healthy skin, it's important to prioritize a balanced diet rich in whole, minimally processed foods such as fruits, vegetables, whole grains, lean proteins, and healthy fats (Frasca and Strbo, 2022) [6]. Additionally, staying hydrated, managing stress, getting regular exercise, practicing good skincare habits, and avoiding excessive alcohol consumption and smoking can all contribute to maintaining clear and radiant skin.

7. Gastrointestinal problems

Ultra-processed foods often contain high levels of added sugars and refined carbohydrates, which can disrupt the balance of bacteria in the gut and contribute to dysbiosis. This imbalance in gut microbiota and lack of fibre can lead to digestive issues such as gas formation, bloating, and diarrhoea. They can slow down digestion and contribute to feelings of heaviness and discomfort in the stomach. These foods contain artificial additives and preservatives, which may irritate the gastrointestinal tract and trigger symptoms of indigestion in sensitive individuals. They are often high in sodium, which can lead to water retention and bloating. Excess sodium intake can also exacerbate symptoms of indigestion, particularly in individuals with hypertension or sodium sensitivity (Yan *et al*., 2022) [18]. Frequent consumption of ultra-processed foods leads to increased risk of digestive disorders such as irritable bowel syndrome (IBS) and acid reflux (Wu *et al*., 2024) [17]. To reduce the risk of indigestion and promote healthy digestion, it's important to prioritize a diet rich in whole, minimally processed foods such as fruits, vegetables, whole grains, lean proteins, and healthy fats.

8. Dental caries

Ultra-processed foods such as candy, sugary snacks, and sweetened beverages, contain high levels of added sugars. Bacteria in the mouth feed on these sugars and produce acids as byproducts, which can erode tooth enamel and lead to the formation of cavities. This prolonged exposure to sugars can increase the risk of dental caries by providing a favorable environment for bacterial growth and acid production. Acidic ingredients or additives, such as citric acid and phosphoric acid, which can weaken tooth enamel and make the teeth more susceptible to decay and increase the risk of dental caries. These foods can also decrease saliva production in the mouth. Reduced saliva flow can therefore contribute to an increased risk of dental caries. Children with 67.7 per cent consumption of ultra- processed foods 4 times or more a day has developed both non-cavitated caries and cavitated caries (Souza *et al*., 2021) [16]. To reduce the risk of dental caries, it's important to limit the consumption of ultra-processed foods high in added sugars and acids. Instead, focus on a balanced diet rich in whole, minimally processed foods like fruits, vegetables, whole grains, lean proteins, and dairy products. Additionally, practicing good oral hygiene habits such as brushing teeth twice a day, flossing daily, using fluoride toothpaste, and visiting the dentist regularly for check-ups and cleanings can help maintain optimal dental health.

Conclusion

Ultra-processed food and lifestyle diseases is a concerning one, underscored by mounting evidence from scientific research. Ultra- processed foods, often high in refined sugars, unhealthy fats, and artificial additives, have been linked to an increased risk of developing various lifestyle diseases, including obesity, type 2 diabetes, cardiovascular diseases, and certain cancers. Frequent consumption of ultra-processed foods is associated with poorer health outcomes. Promoting public awareness about the detrimental effects of ultra-processed foods and advocating for healthier dietary choices is crucial. Additionally, improving food environments through initiatives like subsidizing nutritious foods, implementing front-of-package labelling systems, and regulating marketing practices can help steer

consumers toward healthier options. Ultimately, reducing the consumption of ultra-processed foods and embracing whole, minimally processed alternatives is pivotal for mitigating the burden of lifestyle diseases and promoting overall health and well-being.

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