

Ultra-Processed Diets: The Hidden Threat to Human Health

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ABSTRACT

Ultra-processed foods (UPFs) have become a dominant component of modern diets, accounting for over 50% of daily caloric intake in many populations. These highly industrialized food products ranging from sugary beverages and packaged snacks to instant meals and reformulated “health” foods are often rich in refined carbohydrates, added sugars, unhealthy fats, sodium, and a variety of additives such as emulsifiers, artificial sweeteners, colorants, and preservatives. Accumulating evidence links high UPF consumption to a spectrum of adverse health outcomes, including obesity, cardiovascular disease (CVD), type 2 diabetes, hypertension, inflammatory bowel disease (IBD), irritable bowel syndrome (IBS), and colorectal cancer. Emerging studies suggest that the harmful effects of UPFs may operate through multiple biological pathways, including disruption of the gut microbiome, increased intestinal permeability, chronic inflammation, and impairment of the microbiota–gut–brain axis.

Furthermore, UPFs may exhibit addictive properties by stimulating the brain’s reward circuitry, potentially leading to compulsive eating behaviours that mirror substance use disorders. These addictive patterns are associated with higher dropout rates in weight loss programs and reduced long-term success in obesity treatment. UPFs may also expose consumers to endocrine-disrupting compounds such as bisphenol A (BPA) and inorganic phosphates, both of which are linked to hormonal imbalances, oxidative stress, and increased cardiovascular risk. Additionally, the structural and chemical alterations that occur during food processing can reduce nutrient bioavailability and negatively impact metabolic regulation, lipid profiles, and blood sugar control. Despite the growing body of observational data, clinical trials directly testing the effects of UPFs on gut health, metabolic disease, and long-term outcomes.

Keywords:- Ultra-processed foods (UPFs), Additives (emulsifiers, sweeteners), Obesity, Diabetes, Cardiovascular disease, Gut microbiota, Inflammation, Compulsive eating, Endocrine disruptors, Blood sugar control

INTRODUCTION

Ultra -Processed Foods, Additives, and Gut Health:

Ultra-processed foods (UPFs) and food additives are now a major part of modern diets. Growing research suggests that

eating a lot of UPFs is linked to gut-related health problems like Microbiota Gut Brain axis; Obesity; Cardiovascular disease.

Many UPFs contain food additives such as emulsifiers, sweeteners, colorants, and tiny particles like micro- or nanoparticles.

These additives may affect the gut microbiome, increase intestinal permeability (how easily things pass through the gut wall), and cause inflammation in the gut.

Human clinical trials (the strongest kind of evidence) on UPFs and gut health are still very limited. One study showed that UPFs can lead to increased calorie intake and weight gain, but no trials have directly looked at how UPFs or food additives impact gut diseases (1).

Key Points:

- UPFs are common in today's diets and are linked to a higher risk of gut diseases such as IBD, colorectal cancer, and possibly IBS.
- Proving a direct cause is difficult because most studies are observational and often don't properly measure UPF intake or control for other risk factors.
- Additives used in UPFs—including emulsifiers, sweeteners, colorants, and nanoparticles—have been shown in lab and animal studies to harm gut health.
- While one clinical trial linked UPFs to weight gain, no human trials have examined their direct effects on gut conditions.
- Few studies have tested whether cutting back on food additives improves gut health, though some multi-nutrient diet plans show early potential (2).

Ultra-Processed Foods (UPFs) and Addiction

Over the last 40 years, rates of obesity have risen sharply. One key factor is the increased consumption of ultra-processed foods (UPFs) industrially made products like sugary drinks, packaged snacks, candy, and fast foods. These foods are designed to taste extremely appealing by

adding fats, sugars, and salts. UPFs have been linked not only to obesity but also to diseases like heart disease and type 2 diabetes. Four large studies have shown that people who eat the most UPFs have a 25–62% higher risk of early death compared to those who eat the least.

Interestingly, some UPFs were developed by tobacco companies, who used the same strategies that made cigarettes addictive—like adding chemicals to enhance taste and craving.

Studies now suggest that UPFs may be addictive. They activate the brain's reward system much like addictive substances do, leading to behavior's like cravings, withdrawal symptoms, and continued use despite negative effects. Natural foods (like fruits or vegetables) don't cause the same reactions (3).

Gut Microbiome and their effect on health:

The gut microbiome (also called gut microbiota or commensal microbes) refers to the vast collection of microorganisms living in our digestive tract, especially in the colon. An adult male typically hosts about 38 trillion microbes—more than the number of human cells in the body. Of around 1150 known microbial species in the gut, each person carries at least 160 of them.

These microbes mainly belong to five groups:**1. Firmicutes:**

- Yogurt (with live cultures);
- Sauerkraut (fermented cabbage);
- Kimchi; Pickles (fermented naturally, not vinegar-based);
- Cheese (aged, with live cultures).

2. Bacteroidetes:

- Whole grains (e.g., oats, brown rice, barley)
- Legumes (e.g., lentils, chickpeas, black beans)
- Vegetables (e.g., broccoli, carrots,

- onions)
 - Fruits (e.g., apples, bananas, berries)
 - Nuts and seeds.
- 3. Actinobacteria:**
- Dairy foods (Yogurt; Cheese; Buttermilk)
 - Fermented vegetables (Kimchi; pickles)
 - Plant based (Bananas; onions; garlic; Asparagus)
- 4. Proteobacteria:**
- Fermented foods (Escherichia coli in traditional cheeses)
 - Raw or fermented vegetables
 - Kombucha (can contain some Proteobacteria)
 - Unpasteurized fermented dairy (traditional cheeses, raw milk)
- 5. Verrucomicrobia:**
- Polyphenol-rich foods:
 - Cranberries
 - Pomegranate
 - Green tea
 - Red wine (moderation)
 - Dark chocolate (70%+ cacao).

Firmicutes and Bacteroidetes make up about 90% of the total population. Some microbes, like those from Proteobacteria, are usually harmless but can cause problems under certain conditions, such as in inflammatory bowel disease (IBD).

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A healthy gut microbiome—rich in variety and balance—helps maintain overall health. But when the microbial balance is disrupted (a condition called dysbiosis), it's linked to issues like obesity, diabetes, and gut diseases. Diet plays a major role in shaping the composition and function of the gut microbiome. There's growing

interest in using nutrition to improve gut health or even manage conditions like IBD (4).

HOW FOOD AFFECTS GUT MICROBES

The digestive system breaks down food and absorbs nutrients. It also protects against infections and regulates immunity. Undigested food that reaches the colon becomes food for gut microbes. The three major nutrients—carbohydrates, proteins, and fats—have different effects on the microbiome:

Carbohydrates (especially fiber) are broken down by certain bacteria to produce short chain fatty acids (SCFAs), which are generally beneficial for gut health.

Proteins, when undigested (10–30%), support bacteria that produce not only SCFAs but also harmful substances like ammonia and hydrogen sulphide.

Fats trigger bile acid release. Some of these acids reach the colon, encouraging bacteria that can produce toxic compounds such as hydrogen sulphide (5).

The Microbiota–Gut–Brain Axis (MGB Axis)

These microorganisms live on the skin, in the lungs, mouth, nose, reproductive system, and especially in the gut, where the largest number is found.

Eating too many UPFs can:

- Disrupt gut bacteria (causing an imbalance known as dysbiosis)
- High sugar and processed food
- Artificial sweeteners
- Red and processed meats
- Excess Alcohol
- Low Fiber diet
- Damage the intestinal barrier which protects the body
- Affect brain chemistry, by changing how neurotransmitters (chemical messengers) are made and used in the

- This shows how our diet can affect the gut-brain connection and potentially lead to problems with mood, memory, and behavior (6).

UPF Addiction and Its Role in Obesity and Weight Loss

In recent years, research has shown that addiction to ultra-processed food (UPFs) could play a major role in people struggling with overweight or obesity.

One important study followed 609 adults in a 12-month weight loss program. It found that people who showed signs of UPF addiction at the beginning were:

More likely to drop out of the program
Less likely to lose weight

In fact, UPF addiction was the strongest predictor of poor results—stronger than other factors like emotional eating, stress, depression, sleep quality, or even age and education. This suggests that treating UPF addiction may be key for successful weight loss.

Another study found that during the first year of the COVID-19 pandemic, people with UPF addiction gained six times more weight. They also ate more UPFs and felt more stressed about their eating habits (7).

WHY DO ULTRA-PROCESSED FOODS LEAD TO WEIGHT GAIN

1. Nutritional Profile

Ultra-processed foods tend to be high in calories, fats, sugar, and salt, but low in fibre and nutrients. They often replace healthier, low-calorie whole foods in the diet.

2. Highly Tasty and Easy to Overeat

These foods are designed to taste very good with strong flavors, making it easy to eat more than needed. They don't make people feel full as effectively as whole foods do.

3. Energy Density and Texture

Ultra-processed foods have a lot of

calories packed into small amounts (high energy density) and are often soft and easy to chew, which lets people eat quickly and in large amounts before feeling full.

4. Faster Eating and Lower Satiety Signals

Eating fast can delay feelings of fullness. In fact, studies show people eat faster and feel less satisfied on ultra-processed diets. Also, levels of appetite-suppressing hormones are lower after eating these foods.

5. Convenience and Marketing

Ultra-processed foods are everywhere, cheap, and heavily advertised. This encourages frequent snacking and overeating, sometimes even when people aren't hungry (8).

6. Can Treatments for Obesity Help UPF Addiction Too

A review looked at studies that tested various obesity treatments—like:

- Medications (e.g., naltrexone, bupropion, pexacerfont)
- Bariatric surgery
- Lifestyle changes (counselling, meal planning, exercise)

These studies showed that these treatments also helped reduce UPF addiction. Interestingly, the medications used have also been used to treat drug and alcohol addictions, showing some overlap.

Ultra-Processed Foods and Cardiovascular Risk: A Biological Mechanism

Heart disease is the leading cause of death both globally and in the United States. Among the various risk factors, poor diet stands out as the most significant modifiable contributor, linked to over 50% of heart attacks and strokes. In recent years, the focus of nutrition science has shifted away from individual nutrients—

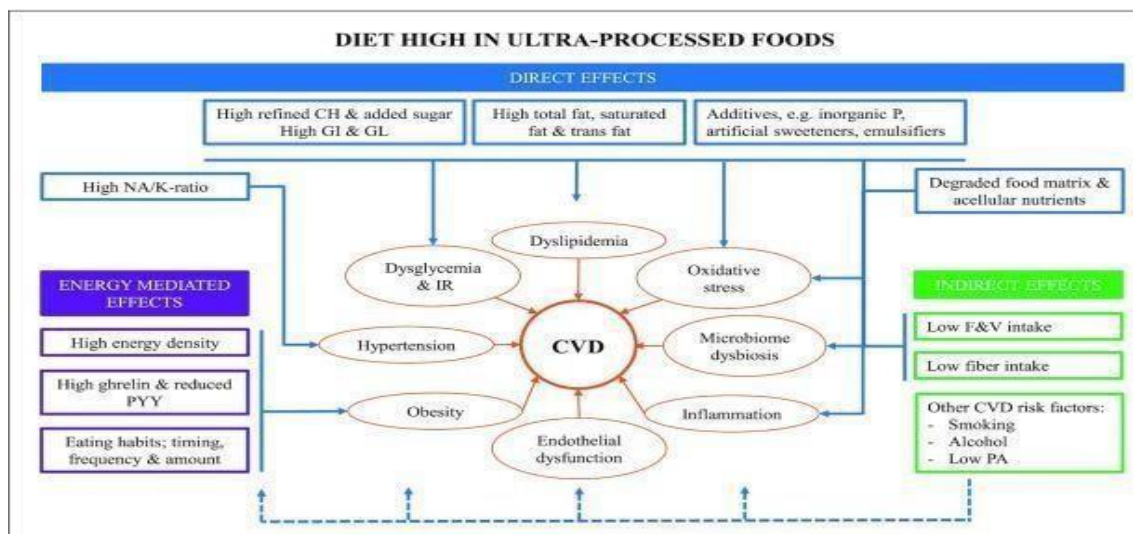
In the United States, UPFs make up more than 50% of the average person's daily

Minimally Processed Foods	Processed Culinary Ingredients	Processed Foods	Ultra-Processed Foods
<p><u>Processing techniques:</u> Cleaning, grinding, drying, fermentation, pasteurization, cooling, freezing, and other processes which do not add substances to the original food.</p> <p><u>Examples of foods:</u> Fresh, dry or frozen fruits or vegetables, grains, legumes, meat, fish and milk, plain unsweetened yogurt, nuts and seeds without added salt or sugar, coffee, tea, herbal infusions.</p>	<p><u>Processing techniques:</u> Pressing, grinding, crushing, pulverizing, and refining of natural foods to obtain ingredients that are used for cooking and seasoning.</p> <p><u>Examples of foods:</u> Plant oils (e.g. olive oil, coconut oil), animal fats (e.g. cream, butter, lard), maple syrup, sugar, honey and salt.</p>	<p><u>Processing techniques:</u> Canning, pickling, smoking, curing, alcoholic and non-alcoholic fermentation.</p> <p><u>Examples of foods:</u> Canned vegetables, meat fish, legumes or fruits, pickled vegetables, salted nuts and seeds, salted, smoked or cured meat or fish, artisanal cheeses and breads, wine, beer and cider.</p>	<p><u>Processing techniques:</u> Series of multiple processes incl. extraction and chemical modification of substances (e.g. oils, starches, sweeteners, emulsifiers), assembly of unmodified and modified food substances and additives, pre-frying, molding, extrusion.</p> <p><u>Examples of foods:</u> Soft drinks, breakfast cereals, fast foods, salty snack foods, industrially produced breads, sweets, canned/instant soups, energy bars, chicken/fish nuggets, hot dogs, fruit drinks and flavored yogurt.</p>

Less processed
More processed

Processing can change the nutrition content and characteristics of food items in such a way that may change their nutritional value. Food processing may also influence long-term dietary behaviors.

The underlying physio-pathological interrelations in atherogenesis and CVD progression are complex and involve multiple pathways. A constellation of factors such as metabolic, proinflammatory, prothrombotic, pro-oxidative, and endothelial dysfunction coexist and potentiate each other. A myriad of nuances exist (10).



Blood Sugar and Insulin Effects

Ultra-processed foods are the main source of added sugars in the American diet, especially through sugary drinks. Eating too much sugar can cause several problems linked to heart disease:

- Excess weight, especially belly fat
- High blood pressure
- Insulin resistance and type 2 diabetes
- Unhealthy cholesterol levels

The way a food affects blood sugar depends on:

How much and what type of carbohydrates it contains

- Amounts of fat, protein, and fibre
- How the food is processed and its structure (solid vs. liquid)

Studies show ultra-processed foods usually cause higher spikes in blood sugar compared to less processed foods. These spikes can promote weight gain, inflammation, and damage to blood vessels.

Low-Calorie Sweeteners

The effects of low-calorie sweeteners (like those in diet sodas) on health are not fully clear. Some research suggests that regularly consuming them may increase the risk of type 2 diabetes. Experimental

studies show that certain sweeteners might interfere with the brain's regulation of blood sugar and reduce how well the body responds to insulin (11).

HYPERTENSION

High blood pressure (hypertension) is a major risk factor for heart disease and stroke. One of the strongest dietary contributors to hypertension is excess sodium (salt) intake.

How Salt Affects Blood Pressure

Although the exact mechanisms are still being studied, research shows that eating too much sodium can affect the body in several harmful ways:

- It can disrupt how the kidneys manage sodium and water, leading to fluid buildup.
- Sodium can directly affect blood vessel walls, making them less flexible and increasing resistance to blood flow.
- It can also influence the nervous system and hormone levels, which play a role in controlling blood pressure.

These effects can lead to water retention, stiff blood vessels, and increased blood volume—all of which raise blood pressure over time. Some people are more

salt-sensitive, meaning their blood pressure rises more easily in response to salt intake. This may be influenced by genetics, age, race, and underlying health conditions (12).

Sodium-to-Potassium Ratio Matters

- It's not just about sodium alone. The balance between sodium and potassium in the diet is also important. Studies show that people with a high sodium-to-potassium ratio (more sodium than potassium in their diets) have a higher risk of dying from heart disease. In contrast, diets rich in potassium—which helps relax blood vessels and excrete excess sodium—are linked to lower blood pressure and better heart health.

The Role of Food Processing

- Most of the sodium in the typical American diet comes from commercially processed and ultra-processed foods—such as packaged snacks, canned soups, deli meats, fast foods, and frozen meals. These products are often loaded with added salt for flavor, texture, or preservation.
- In contrast, minimally processed foods—such as fruits, vegetables, milk, and legumes—are naturally low in sodium and high in potassium. When diets are high in ultra-processed foods and low in whole, potassium-rich foods, this shifts the sodium to-potassium balance in an unhealthy direction, increasing the risk of hypertension and cardiovascular disease (13).

Plasma lipid profile

- Plasma lipid concentrations—particularly levels of LDL cholesterol, HDL cholesterol, and triglycerides—are closely influenced by the quality and quantity of dietary fats and

carbohydrates, which in turn are significantly affected by the degree of food processing.

Dietary foods and Trans fatty acids

1. Trans Fats and Health Risks:

- Industrial trans fats (from partially hydrogenated oils) are harmful. They raise LDL (bad) cholesterol and lower HDL (good) cholesterol. This increases the risk of coronary heart disease (CHD). FDA has taken action to remove trans fats from the food supply.

2. Saturated Fats – Not All Are Equal:

- Saturated fats have long been linked to higher LDL cholesterol.
- Found in both minimally processed foods (e.g., full-fat dairy, unprocessed meats) and ultra-processed foods (e.g., palm oil, processed fats).

3. Effect of Processing:

- High-heat processing of fats can create harmful byproducts. These may pose a greater heart risk than saturated fat itself.
- Example: Processed coconut oil raises cholesterol in animals, while virgin coconut oil does not (14).

4. New Research Insights:

- Some studies show full-fat dairy and unprocessed red meat do not significantly increase heart disease or metabolic risks.
- Challenges old views that all saturated fats are harmful.

5. Current Expert View:

- Focus is shifting from specific nutrients to whole foods and processing level.
- It's better to consider the whole food matrix and how the food is processed when evaluating health impacts (15).

Endocrine pathways**(Phosphorus Intake and Hormonal Regulation):**

Source: Industrial food processing often adds inorganic phosphate salts, leading to high phosphorus intake.

Absorption: Inorganic phosphate (80–100%) is absorbed more efficiently than organic phosphorus from natural foods (40–60%).

Hormonal Disruption: Excess phosphorus intake triggers increased secretion of parathyroid hormone (PTH) and fibroblast growth factor 23 (FGF23).

Both PTH and FGF23 promote arterial calcification, contributing to cardiovascular disease (CVD).

Other Effects: Elevated phosphate levels increase oxidative stress on endothelial cells and impair endothelial function, further escalating CVD risk.

Bisphenol A (BPA) as an Endocrine Disruptor:

Source: BPA is found in packaging materials of industrially processed foods.

Association with CVD Risk Factors: Higher BPA exposure is linked epidemiologically to diabetes, obesity (overall and abdominal), and hypertension.

Mechanisms: BPA mimics 17 β -estradiol, binding to estrogen-related receptors. This binding promotes insulin resistance, oxidative stress, inflammation, adipogenesis, and pancreatic β -cell dysfunction.

Exposure: Primarily through foods stored or reheated in BPA-lined containers.

Mitigation: Diets rich in minimally processed or fresh foods are associated with lower BPA levels.

Substitutes: BPA replacements like bisphenol S and F may have similar endocrine-disrupting effects, raising safety concerns.

CONCLUSION

The rising consumption of ultra-processed foods represents one of the most pressing nutritional and public health challenges of

our time. These foods, designed for hyper-palatability and convenience, are not only nutritionally inadequate but also contribute to systemic biological disruptions that span the gastrointestinal, cardiovascular, metabolic, endocrine, and neurological systems. From increasing inflammation and altering gut microbiota to impairing hormone regulation and fostering food addiction, UPFs exert their harmful effects through a complex web of physiological mechanisms. Evidence now suggests that UPFs promote dysbiosis, reduce microbial diversity, increase gut permeability, and facilitate the production of harmful microbial metabolites. This can contribute to a cascade of health issues— including immune dysfunction, mood disorders, and cardiometabolic disease— through the microbiota– gut–brain axis. Furthermore, UPFs are associated with altered satiety signaling, rapid glycemic fluctuations, poor lipid profiles, and chronic weight gain due to their energy density, soft texture, and low fiber content. Endocrine disruptors like BPA and inorganic phosphates—commonly found in UPF packaging and additives—further compound these risks by promoting oxidative stress, vascular dysfunction, and hormonal imbalances that are now being implicated in the development of diabetes, hypertension, and atherosclerosis.

The concept of UPF addiction introduces an additional layer of complexity to dietary behavior and obesity management.

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