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The effects of ultra-processed food intake on human gut health

ულტრადამუშავებული საკვების მოხმარების გავლენა ადამიანის ნაწლავების ჯანმრთელობაზე

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Abstract

Introduction: Ultra-processed foods (UPFs), characterized by high levels of additives, preservatives, sweeteners, and artificial ingredients, have become prevalent in modern diets, particularly in developed countries. Growing evidence indicates that regular consumption of UPFs is associated with alterations in gut microbiota, increased intestinal permeability, and systemic low-grade inflammation, factors contributing to various chronic diseases, including gastrointestinal, cardiometabolic, and neuropsychiatric disorders. **Methods:** A comprehensive literature review was conducted using PubMed, Scopus, and Google Scholar. Peer-reviewed, open-access articles published in English from 2011 to 2022 were included. The review focused on observational and clinical studies examining the relationship between UPF intake, gut microbiota composition, and associated health outcomes. **Results:** UPF consumption was consistently linked to reduced microbial diversity and the depletion of beneficial bacteria such as Faecalibacterium prausnitzii, Roseburia, and Akkermansia muciniphila. Simultaneously, an increase in pro-inflammatory bacterial species was observed. Additives such as emulsifiers, artificial sweeteners, nanoparticles, and coloring agents were shown to disrupt the gut barrier, promote dysbiosis, and elevate systemic inflammation. High UPF intake correlated with greater prevalence of metabolic syndrome, inflammatory bowel disease (IBD), and mental health conditions. **Discussion:** The findings emphasize a strong connection between UPF-induced dysbiosis and chronic inflammation. Key mechanisms include decreased production of short-chain fatty acids (SCFAs), weakened gut barrier integrity, and endocrine-disrupting effects of food packaging chemicals like bisphenols. Emerging research also links gut dysbiosis to brain function via the microbiota-gut-brain axis, implicating UPFs in the development of cognitive and psychiatric disorders. **Conclusion:** UPFs significantly compromise gut health by disrupting microbial balance and enhancing intestinal permeability, which in turn fosters systemic inflammation and chronic disease. Public health efforts should focus on reducing UPF consumption through education, clearer labeling, and regulatory policies. Future research must further elucidate causal pathways and develop microbiota-targeted dietary interventions to protect gastrointestinal and overall health.

Keywords: Ultra-processed foods, gut microbiota, intestinal permeability, chronic inflammation, dysbiosis, emulsifiers, sweeteners, microbiota-gut-brain axis, metabolic syndrome, gastrointestinal disorders.

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აბსტრაქტი

შესავალი: ულტრადამუშავებული საკვები პროდუქტები (UPF), რომლებიც ხასიათდება მაღალი რაოდენობით დანამატებით, კონსერვანტებით, დამტკბობლებით და ხელოვნური ინგრედიენტებით, თანამედროვე დიეტის მნიშვნელოვან ნაწილს წარმოადგენს, განსაკუთრებით განვითარებულ ქვეყნებში. მზარდი მტკიცებულებები მიუთითებს იმაზე, რომ ულტრადამუშავებული საკვების რეგულარული მოხმარება უკავშირდება ნაწლავის მიკრობიოტას ცვლილებებს, ნაწლავის განვლადობის ზრდას და სისტემურ დაბალინტენსიურ ანთებას — რაც მრავალი ქრონიკული დაავადების, მათ შორის გასტროენტეროლოგიური, კარდიომეტაბოლური და ნეიროფსიქიატრიული დარღვევების გამომწვევი ფაქტორია. **მეთოდები:** ჩატარდა ყოვლისმომცველი ლიტერატურის მიმოხილვა PubMed-ის, Scopus-ისა და Google Scholar-ის მონაცემთა ბაზებში. განხილული იქნა 2011-2022 წლებში ინგლისურ ენაზე გამოქვეყნებული რეცენზირებული, ღია წვდომის მქონე სტატიები. წინამდებარე მიმოხილვა მოიცავს იმ დაკვირვებითი და კლინიკური კვლევების განხილვას, რომელთა მიზანი იყო გამოვლენილიყო კავშირი ულტრადამუშავებული საკვების მოხმარებასა და ნაწლავის მიკრობიოტას შორის. **შედეგები:** აღმოჩნდა მკაფიო კავშირი UPF-ის მოხმარებასა და ნაწლავის მიკრობიოტას მრავალფეროვნების შემცირებას შორის, მათ შორის ისეთი სასარგებლო ბაქტერიების რაოდენობის კლება, როგორიცაა Faecalibacterium prausnitzii, Roseburia და Akkermansia muciniphila. ამავე დროს, მატულობდა ანთებითი პროცესების ხელშემწყობი ბაქტერიების რაოდენობა. ემულგატორები, ხელოვნური დამტკბობლები, ნანონაწილაკები და საკვები საღებავები ასუსტებს ნაწლავის ბარიერს, იწვევს დისბიოზს და ხელს უწყობს სისტემურ ანთებას. მაღალი UPF მოხმარება კავშირშია მეტაბოლური სინდრომის, ანთებითი ნაწლავის დაავადებების (IBD) და ფსიქიკური ჯანმრთელობის პრობლემების გავრცელებასთან. **დისკუსია:** მიღებული შედეგები ხაზს უსვამს UPF-ით გამოწვეულ ნაწლავის დისბიოზისა და ქრონიკული ანთების მჭიდრო კავშირს. მთავარი მექანიზმებია SCFA-ების (მოკლემოლეკულური ცხიმოვანი მჟავები) შემცირებული წარმოება, ნაწლავის ბარიერის დაქვეითება და საკვების შეფუთვაში არსებული ქიმიური ნივთიერებებით (მაგ., ბისფენოლების) გამოწვეული ენდოკრინული დარღვევები. ახალი კვლევები მიუთითებს, რომ მიკრობიოტას დისბალანსი გავლენას ახდენს ტვინის ფუნქციონირებაზე, ამასთანავე UPF-ის მოხმარება ხელს უწყობს კოგნიტურ და ფსიქიურ დარღვებებს. **დასკვნა:** ულტრადამუშავებული საკვები პროდუქტების მოხმარება მნიშვნელოვან საფრთხეს უქმნის ნაწლავის ჯანმრთელობას, იწვევს მიკრობიოტის დისბალანსს და ზრდის ნაწლავის განვლადობას, რის შედეგადაც ვითარდება სისტემურ ანთებითი პროცესები და ყალიბდება ქრონიკული დაავადებები. საზოგადოებრივი ჯანდაცვის პოლიტიკაში პრიორიტეტად უნდა იქცეს UPF-ის მოხმარების შემცირება განათლების, ეტიკეტირების გაუმჯობესებისა და რეგულაციების გზით. მომავალი კვლევები უნდა კონცენტრირდეს მიზეზშედეგობრივი კავშირების დადგენასა და ნაწლავის მიკრობიოტაზე ორიენტირებული დიეტური ჩარევების განვითარებაზე.

საკვანძო სიტყვები: ულტრადამუშავებული საკვები, ნაწლავის მიკრობიოტა, ქრონიკული ანთება, დისბიოზი, ემულგატორები, მეტაბოლური სინდრომი, გასტროენტეროლოგიური დარღვევები.

ციტატა: ჯისნა ჯოი, სოფიო ტატიშვილი. ულტრადამუშავებული საკვების მოხმარების გავლენა ადამიანის ნაწლავების ჯანმრთელობაზე. ჯანდაცვის პოლიტიკა, ეკონომიკა და სოციოლოგია. ჯანდაცვის პოლიტიკა, ეკონომიკა და სოციოლოგია, 2025; 9 (1). https://doi.org/10.52340/healthecosoc.2025.09.01.10.

Introduction

The human diet is undergoing rapid transformation, influenced by changes in population structure, urbanization, and workforce dynamics, and driven by advancements in agricultural and food industry technologies (Vermeulen et al., 2020). Agricultural practices have evolved over centuries, shifting from localized, small-scale production to mechanized systems capable of feeding global populations (Vermeulen et al., 2020). At the same time, innovations in food engineering and the use of food additives have led to the creation of ready-to-eat products with appealing visual and sensory qualities, extended shelf lives, and minimal preparation requirements (Laudisi et al., 2019). These developments have significantly altered the global food supply, making it vastly different from that of previous eras and contributing to substantial changes in dietary patterns, often associated with a rise in chronic diseases, including various gastrointestinal disorders (Laudisi et al., 2019).

Ultra-processed foods (UPFs) are central components of this transformation and are now widely consumed, especially in developed countries. A growing body of evidence suggests a link between UPF-rich diets and gastrointestinal disorders. Furthermore, certain additives commonly found in UPFs, such as emulsifiers, artificial sweeteners, colorants, and nanoparticles, appear to alter gut microbiota composition and intestinal permeability in ways that may exacerbate chronic inflammation (Brichacek, 2024). Most UPFs are energy-dense yet deficient in protein, fiber, and essential micronutrients, including potassium, magnesium, vitamins C and D, zinc, phosphorus, vitamin B12, and niacin. They are typically high in added additives and salt (Daniela et al., 2021).

The goal of this research is to investigate how the consumption of ultra-processed foods affects gut health, particularly by examining their impact on gut microbiota composition, immune function, and inflammation pathways. This study aims to contribute to the growing understanding of the mechanisms through which dietary patterns influence chronic disease risk.

This research addresses the following questions:

- How does regular consumption of UPFs alter the composition and diversity of the gut microbiota?
- How does early-life exposure to UPFs influence gut microbiota development and long-term health outcomes?
- What role does UPF-induced gut dysbiosis play in promoting systemic low-grade inflammation?

Methodology

A comprehensive literature review was conducted. Three databases—PubMed, Scopus, and Google Scholar, were used for the search. Both keywords and Medical Subject Headings (MeSH) terms were applied. The search was limited to open-access, peer-reviewed journal articles published in English between 2011 and 2022 to ensure access to recent and reliable publications.

The study framework was based on observational research, including cross-sectional, case-control, cohort studies, and relevant clinical trials. Only studies with full-text open access were included to ensure availability of complete data for analysis.

Exclusion criteria included:

- Articles not subjected to peer review (e.g., editorials, opinion pieces, and conference abstracts);
- Articles lacking a clear methodological framework or measurable outcomes.

Only articles published in English were considered for inclusion.

Literature Review

Although their definition is up for controversy, UPFs are commonly present in the food supply. Historically, names like "convenience food," "fast food," or "junk food" have been employed despite their unfavorable connotations and lack of sound criteria (Whelan et al, 2024). When Monteiro et al. introduced the NOVA classification in 2009, they first brought attention to the potential function of UPF in the link between nutrition and health. (Monteiro et al, 2009)

Instead of classifying foods based on the nutrients they contain, the NOVA system categorizes them on the kind, scope, and intent of the manufacturing procedures they go through (Brichacek et al, 2024). Foods fall into one of four categories in this classification: Group 1 comprises unprocessed or lightly processed foods, such as the edible components of plants or animals that are directly harvested or minimally modified/preserved (Daniela et al, 2021), Group 2 comprises refined cooking essentials like salt, sugar, oil, or starch that are made from Group 1 foods (Daniela et al, 2021) and Group 3 comprises processed foods like canned vegetables or freshly baked bread that are made by combining Group 1 and Group 2 foods. Group 4 comprises ultra-processed foods (UPFs), characterized as compositions of components predominantly intended for industrial processes, which retain little to no intact food components and are generally produced by various industrial techniques and procedures. (Brichacek et al, 2024)

Highly processed food products are commonly included in diets, though their consumption varies significantly by country. A comprehensive review of 99 investigations involving 1,378,454 participants from 20 nations documented that UPF intake among adults ranges from 10% of energy consumption in Italy to 59.7% in the United States (Whelan et al, 2024). Longitudinal studies indicate that there is a trend toward increased UPF consumption, with figures rising in Canada from 24.4% of total energy in 1938 to 54.9% in 2001, and in Sweden, an increase of 142% was observed between 1960 and 2010 (Whelan et al, 2024). Additionally, among young individuals aged 2 to 19 in the USA, UPF consumption grew from 61.4% of overall energy intake in 1999 to 67% in 2018. (Whelan et al, 2024)

Evidence from cohort studies suggests an association between increased consumption of heavily processed foods and higher rates of mortality and morbidity (cardiovascular disease, type 2 diabetes mellitus, and cancer) (Whelan et al, 2024). Additionally, a meta-analysis of observational studies has indicated a heightened risk of overweight, obesity, metabolic syndrome, and depression. (Whelan et al, 2024)

Crucially, there is growing evidence that UPF contributes to an elevated risk of gastrointestinal disorders, such as inflammatory bowel disease (IBD), functional gastrointestinal disorders (FGIDs), and various intestinal cancers. (Whelan et al, 2024)

Food enhancers

Preservatives have been incorporated into products for a long time to improve foods' texture, flavor, appearance, and shelf life (Whelan et al, 2024). The European Union defines food additives as "substances that are added to food intentionally for a technological purpose but are not normally consumed as food itself" (Whelan et al, 2024)

Food enhancers consumption and use are increasing as a result of the expanding need for convenient goods with extended shelf lives. (Whelan et al, 2024)

Governing assemblies differ in the types of additives they include and which compounds fall into which categories. Enhancers are divided into colors, sweeteners, and "additives other than colors and sweeteners," while in other parliamentary bodies, they are divided into purpose-based groups that include colors, sweeteners, emulsifiers, stabilizers, gelling agents, and thickeners. (Whelan et al, 2024)

Food emulsifiers

Emulsifiers are food additives blended in highly processed foods to enhance their sensory features and prolong their durability (Whelan et al, 2024). They are described as substances that create or preserve a homogeneous blend of multiple food elements (such as water and oil). (Whelan et al, 2024)

Artificial sweeteners

Due to rising rates of excessive body weight and adult-onset diabetes, numerous individuals have been encouraged to replace sugar with substitutes (Whelan et al, 2024). These synthetic sweeteners are used in place of caloric options, offering a much greater sweetness than common sugars like sucrose and corn-derived syrups (Whelan et al, 2024). The majority of them transit the gastrointestinal tract without undergoing digestion by the body, resulting in direct contact with the microbiota. (Whelan et al, 2024)

Food colors

Food colorants are substances that are added to food to restore color that has been lost (for instance, as a result of interaction with environmental factors), to improve inherently present colors, or to give food that would otherwise be colorless or colored differently some color. (Whelan et al, 2024) Colors in food don't have any nutritional value. (Whelan et al, 2024)

Microparticles/nanoparticles

Dietary microparticles are tiny inorganic particles, similar in size to bacteria, commonly used as enhancers to modify color, texture, or aspect (Whelan et al, 2024). They are present in toothpaste and serve as carriers or coatings in various products, known for their stability and resistance to degradation (Whelan et al, 2024). The utmost popular microparticles are inorganic compounds of silicon dioxide (SiO_2; E551), titanium dioxide (TiO_2; E171), and aluminum silicate (AlSi; E559). (Whelan et al, 2024).

While aluminum silicates are used as anti-caking agents, titanium dioxide has been used as a brightening compound, a clouding agent in dairy substitutes, a flour bleaching agent, and to differentiate layers of different colors in sweets (Whelan et al, 2024). Microparticle food additives are likely to be significantly contaminated by nanoparticles, which are capable of entering cell membranes, though it doesn't breach the intact intestinal mucus layer. (Whelan et al, 2024)

Gut wall integrity

An emerging amount of information suggests that UPF intake can cause major variations within the framework and function of the microbes in the gut (Rondinella et al, 2025). UPFs, which include chemicals, preservatives, emulsifiers, and artificial substances, alter the microbial environment, resulting in the expansion of inflammation-promoting strains and decreased bacterial variety (Rondinella et al, 2025). Regarding functionality, UPF intake is associated with a reduction in SCFA synthesis and other defensive metabolites by the microbiota (Rondinella et al, 2025). The noticed alterations in its makeup and activity may have extensive implications on physical well-being, leading to baseline inflammation and oxidative damage, which happen to be key ingredients in the beginning of numerous forms of chronic illnesses associated with UPF food intake. (Rondinella et al, 2025)

People with high UPF consumption had higher concentrations of potentially dangerous bacterial groups than people with limited consumption (Rondinella et al, 2025). Among these were Blautia, Carnobacterium, Bacteroidaceae, Peptostreptococcaceae, Bacteroidia, and Bacteroidetes, as well as Granulicatella, which has been connected to metabolic problems (Rondinella et al, 2025). On the other hand, Lachnospiracae and Roseburia, which are established to create short-chain fatty acids (SCFAs), were shown to be less prevalent in those with high UPF consumption. Commonly used emulsifying agents, such as gums, carrageenan, polysorbate 80 (P80), and carboxymethylcellulose (CMC), can promote alterations of the gut microbiota, creating a pro-inflammatory microbial environment that may contribute to the development of metabolic diseases like obesity and type 2 diabetes. (Rondinella et al, 2025)

These emulsifiers reduce the number of good microbes like Akkermansia muciniphila and Faecalibacterium prausnitzii, which have anti-inflammatory qualities and negatively impact the intestinal mucus layer, increasing permeability (also known as "leaky gut") and bacterial entry into the circulation, which may cause generalized inflammation. (Rondinella et al, 2025)

UPFs also frequently include a lot of saturated fat. This is due to the addition of components like butter, refined vegetable oils, and animal fats to boost their amount throughout the industrialization process (Rondinella et al, 2025). Although the purpose of these additives is to enhance flavor, texture, and shelf life, their high saturated fat content can be harmful to health, since it's consumption can contribute to the development of cardiovascular disease (Rondinella et al, 2025). The regulation of gut bacterial populations is also affected by diets high in fat; pro-inflammatory cytokines (IL-1, IL-6, and TNF-α) are increased, and the proportion of Firmicutes and Proteobacteria is increased while Bacteroides, Verrucomicrobia, Eubacterium rectale, Clostridium coccoides, and Bifidobacterium groups decrease. (Rondinella et al, 2025)

Furthermore, saturated fat causes hyperinsulinemia, overwhelming lipid buildup in the liver and adipose tissue, and a rise in the quantity of plasma endotoxin produced by Gram-negative bacteria (Rondinella et al, 2025). Frequent use of UPFs has a detrimental impact on metabolic profiles and gut microbiota, significantly reducing beneficial species that are essential for preserving gut health through fiber fermentation and SCFA production. (Rondinella et al, 2025)

UPF and low-grade inflammation

There are several ways in which UPF use may exacerbate inflammation (Asensi et al, 2023). First, the development of chronic inflammation may be directly facilitated by the increased consumption of sweets, salt, saturated fats, and trans fatty acids that characterize a diet high in UPF. (Asensi et al, 2023)

A high simple sugar content, in the form of sucrose or high-fructose syrup, is characteristic of UPF, which means they often cause sharp and rapid blood glucose spikes, i.e., with a high glycemic index/glycemic load. (Asensi et al, 2023)

Regarding UPF's fat content, its inflammatory risk stems from both a lower quality and a greater quantity eaten in comparison to other meals (Asensi et al, 2023). A greater prevalence of mild, persistent inflammation is linked to trans fatty acids produced by industrial processes. (Asensi et al, 2023) In particular, they have been linked to increased hs-CRP, IL-6, and TNF-α levels (Asensi et al, 2023). UPF diets have been linked to increased consumption of omega-6 fatty acids, which raises the omega-6/omega-3 ratio and could contribute to low-grade inflammation. (Asensi et al, 2023)

Finally, overuse of UPF might lead to the substitution of foods that are essential to a nutritious and complete diet (Asensi et al, 2023). Fresh produce, for example, has been linked to an anti-inflammatory impact due to its high concentration of phytocompounds (Asensi et al, 2023). Recent studies clearly reveal that persons who consume more UPF eat less fruit and vegetables and hence consume fewer anti-inflammatory chemicals (Asensi et al, 2023). Poor fruit and vegetable eating leads to a poor dietary consumption of fiber (Asensi et al, 2023). According to the E-DIITM (Energy-Adjusted Dietary Inflammatory Index (E-DII™), roughage is one of the elements that minimizes diet-mediated inflammatory response (Asensi et al, 2023). Other research has demonstrated that appropriate fiber consumption is critical for maintaining low CRP levels and gut microbial equilibrium. (Asensi et al, 2023)

When we look at the non-nutritional aspect, non-essential components, like bisphenol or phthalates, might be found in UPF as a result of chemical migration from food packaging (Asensi et al, 2023). Several cross-sectional studies found that those who consumed a lot of UPF had greater amounts of both chemicals in their urine (Asensi et al, 2023). Because of their structure, bisphenols and phthalates are known as endocrine disruptors (Asensi et al, 2023). They can disrupt hormone production, secretion, transport, signaling, and metabolism, and may contribute to obesity, diabetes, and heart disease. (Asensi et al, 2023)

Greater interaction with Bisphenol A (BPA) is markedly linked with elevated concentrations of IL-6 and CRP, while elevated phthalate interaction is linked to increased CRP, IL-6, and IL-10, according to a new analysis examining the effects of various hormone-altering agents on the immune activation (Asensi et al, 2023). Although BPA's negative effects have resulted in a number of limits on its usage, the consequences of the analogs that took its place seem to be comparable (Asensi et al, 2023). However, because of the heat treatment that food undergoes, UPF could contain compounds that are obtained from food preparation (Asensi et al, 2023). For instance, acrylamide, which is produced when amino acids and carbohydrates undergo the Maillard reaction, has been linked in adults to higher levels of inflammatory biomarkers, including CRP and Mean Platelet Volume (MPV) (Asensi et al, 2023). Acrolein is another substance that comes from lipid oxidation; excessive exposure to this substance has been linked with greater concentrations of Hs-CRP in American adults and CRP in Chinese people. (Asensi et al, 2023)

Microbiome disruption from UPF and its effect on the human body

A diet high in UPFs causes intestinal barrier dysfunction, increased gut permeability, and an imbalance in the gut flora, as was previously described (Rondinella et al, 2025). This causes a state of systemic low-grade inflammation by allowing dangerous bacterial compounds, such as LPS, to enter the bloodstream (Rondinella et al, 2025). The complicated illnesses known as noncommunicable chronic disorders (NCDs), which are marked by disturbed gut microbiota balance and persistent, low-grade inflammation, are becoming more common as a result of this process (Rondinella et al, 2025). Cardiometabolic diseases like T2DM and CVD are among these ailments (Rondinella et al, 2025). In addition, this group includes chronic diseases of the alimentary tract such as irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD) (Rondinella et al, 2025). Moreover, the inflammatory processes are connected to mental and neurological disorders. (Rondinella et al, 2025)

Cardiometabolic disorders:

At least three of the five criteria about central obesity, hypertension, hyperglycemia, hypertriglyceridemia, and low serum HDL are satisfied by the metabolic syndrome, a pathologic disease of physiological process (Rondinella et al, 2025). It is associated with an elevated risk of CVD and type 2 diabetes (Rondinella et al, 2025). An imbalance in the gut microbiome, which is marked by decreased bacterial variety and heightened ability to absorb energy and create toxic chemicals like TMAO (trimethylamine N-oxide), has been linked to obesity, metabolic syndrome, and other conditions. (Rondinella et al, 2025)

An elevated risk of cardiometabolic disorders is associated with higher TMAO production (Rondinella et al, 2025). For example, fasting TMAO levels were linked with significant unfavorable CVD events throughout a 3-year monitoring phase in a trial of subjects receiving elective coronary angiography (Rondinella et al, 2025). Furthermore, 5-year all-cause mortality was greater among individuals with coronary artery disease and higher TMAO levels, potentially as a result of TMAO's atherogenic effects. (Rondinella et al, 2025)

Severe and recurring inflammation of the intestinal mucosa is a defining trait of IBD, namely Crohn's disease (CD) and ulcerative colitis (UC) (Rondinella et al, 2025). Numerous variables, such as hereditary risk and interaction with harmful environmental circumstances, can contribute to IBDs (Rondinella et al, 2025). Through a variety of processes, including weakened intestinal barrier activity and increased porosity, along with elevated immune response, it has been shown that dysfunction in the microbiome of individuals with IBD contributes to the course of the illness. (Rondinella et al, 2025)

Notably, tryptophan metabolism, bile acid metabolism, and SCFA synthesis are the three primary pathways that are impacted in IBD patients (Debora et al, 2025). These modifications help to maintain and encourage intestinal inflammation.

Cancer risk

As mentioned earlier, a chronic inflammatory state brought on by dysbiosis is a hallmark of both IBD and cardiometabolic illnesses, and it is important at different phases of the development of cancer (Rondinella et al, 2025). However, given that the incorporation of contemporary way of life has often been accompanied by an increase in the prevalence of colorectal cancer (CRC), the modern diet has become a major element affecting the prevalence of CRC worldwide (Rondinella et al, 2025). There is growing evidence that patients with MGB dysbiosis are typified by a decrease in microbiome diversity, a rise in pathobionts, and a loss of anti-inflammatory microorganisms.

The influence of UPF uptake on the microbiota-gut-brain communication pathway

Numerous facets of host physiology, such as food digestion, metabolism, and immune control, are significantly influenced by the human microbiome, a complex system of bacteria that reside in the human intestinal column (Song et al, 2023). Numerous studies have shown that MGB signaling and the pathophysiology of illnesses of the nervous system are closely related (Song et al, 2023). Through food digestion and fermentation, the gut microbiota can create compounds that either directly or indirectly affect brain functioning, for example, by influencing the immune system (Song et al, 2023). However, diets heavy in fat and added sugar damage intestinal permeability and compromise the strength of the blood-brain barrier (BBB). (Song et al, 2023)

UPF may change the gut microbiota's makeup and metabolism, resulting in inflammatory reactions and metabolic abnormalities that raise the risk of neurological diseases.

According to (Holder et al.,2019), some emulsifiers, such as polysorbate 80 (P80) and carboxymethylcellulose (CMC), can directly impact intestinal inflammation and microbiota and nervous tendencies (Lane et al, 2024).

Environmental variables, including nutrition, lifestyle, and gut microbiome composition, are directly related to mental health and cognitive performance (Song et al, 2023). This reciprocal relationship connecting the body and the mind, which affects equilibrium through bacterial byproducts, digestive function, and general well-being, is known as the "gut-brain axis."(Song et al, 2023) Because of this complex relationship, alterations in the makeup of the microbiome can result in psychopathological disorders as depressive disorder, Parkinson's disease, and Alzheimer's disease (AD). (Song et al, 2023)

Discussion

Research has demonstrated that UPFs significantly change the gut microbiota's makeup and function. They decrease supportive bacteria that produce SCFAs, such as Lachnospira, Roseburia, and Faecalibacterium prausnitzii, while increasing the growth of inflammation-activating bacteria and lowering bacterial variety (Rondinella et al, 2025). Elevated gut permeability and systemic exposure to microbial toxins such as lipopolysaccharides (LPS) result from these alterations, which also impair the gut's capacity to maintain intestinal homeostasis (Rondinella et al, 2025).

The significant and varied consequences of processed foods on the microbiome and the health consequences that follow. The subtle balance of the microbiome ecology is upset by synthetic substances, binding agents, preservative chemicals, and enhancers that lead to inflammation (Whelan et al, 2024). In addition to an increased likelihood of persistent illnesses including colorectal cancer, CVD, and MetS, these changes are linked to detrimental metabolic, gastrointestinal, and neuropsychiatric effects (Rondinella et al, 2025).

Furthermore, the mucosal barrier is directly disrupted and bacterial translocation is encouraged by food additives used in UPFs, especially emulsifiers such as polysorbate 80 and carboxymethylcellulose. Similarly, artificial sweeteners cause selection pressures on the microbiota, which exacerbates dysbiosis, because they are poorly absorbed (Rondinella et al, 2025). The inflammatory response can be exacerbated by food coloring and nanoparticles, particularly titanium dioxide, which can cause oxidative stress and immunological activation within the gastrointestinal environment (Whelan et al, 2024). Through modifications in the microbiota-gut-brain axis, new research also links imbalances in the microbiome to the pathophysiology of neuropsychiatric and neurodegenerative diseases (Song et al, 2023). Bisphenol A and phthalates, two chemical pollutants found in food packaging materials, may also exacerbate endocrine disruption and systemic inflammation (Asensi et al, 2023).

Previous research suggests that all of these factors may be responsible for the rising prevalence of several chronic noncommunicable illnesses in tandem with UPF use. Higher processed food consumption is substantially linked to an elevated risk of multiple comorbidities in adulthood, according to many meta-analyses. An increased incidence of mental distress and low mood, and deaths from any cause have also been linked to higher UPF intake (Rondinella et al, 2025). Obesity and overweight were reported to have substantial associations in children and adolescents.

Conclusion and recommendations

UPF production and consumption have increased dramatically in recent decades and are now staples in the meals of people all throughout the world (Monteiro et al, 2009). Although UPF is tasty and practical, it's vital to consider the possible health hazards. According to this article, UPF may alter the makeup of the microbiome, which can result in inflammation, metabolic dysbiosis, and impaired brain function from the standpoint of the MGB axis (Song et al, 2023).

The intricate balance of the intestinal flora ecology is upset by additives, emulsifiers, artificial sweeteners, and preservatives that increase gut permeability, reduce microbial diversity, and disrupt the microbiome (Debora et al, 2025).

Rapid advancements in the study of the intestinal microbiota have made it possible to gather data over the past ten years that suggests a key role for UPF uptake, and food consumption, on bowel health and in the points to a significant role of diet, particularly highly processed food intake, in shaping gut health and driving gastrointestinal diseases (Brichacek et al, 2024). Despite the identification of numerous suspects, preservatives used extensively by the processing manufacturers appear to contribute negatively to shaping the digestive environment (Laudisi et al, 2019). Ambitious RCTs are beginning and are expected to increase our knowledge of the health concerns of people with gastrointestinal illnesses who may and may not consume, despite the many obstacles in this field of study.

On a larger scale, lowering UPF consumption by regulatory actions, education, and clear labeling must be a top priority for public health initiatives (Lane et al, 2024; Monteiro et al, 2009). To create evidence-based recommendations for better eating habits, future studies should keep clarifying the complex processes that connect UPFs to alterations in intestinal flora (Lane et al, 2024).

To protect intestinal health and general well-being, cooperation at the individual, social, and policy levels is essential (Lane et al, 2024). Dietary fiber consumption should get special consideration. Whole grains, legumes, nuts, and seeds are examples of foods high in fiber that give good gut bacteria substrates. Including probiotic-rich products like yogurt, kefir, sauerkraut, kimchi, and miso is another successful tactic (Rondinella et al, 2025). Probiotics, or live strains, are abundant in specific dishes, which can have a good outcome on the makeup of the digestive microbiome. Frequent ingestion of these meals can improve gut health by reestablishing microbial equilibrium and counteracting the dysbiotic effects of UPFs (Debora et al, 2025).

Dietary recommendations, nutritional promotions and advertising, and more comprehensive dietary system modifications should be the main areas of policy interventions to examine their impact on gastrointestinal function (Lane et al, 2024). Education campaigns aimed at the general public and medical experts can raise knowledge of the consequences of synthetic food products on health. The advantages of fermented foods, dietary fiber, and a variety of dietary patterns for microbial health should be emphasized in these efforts. The allure of UPFs can be reduced by enacting stronger laws governing advertising, including internet channels and container designs.

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