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Review on ultra-processed food and its health impact

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Abstract
Global food systems are no longer viable for small farmers, the environment, gastronomic customs, socioeconomics, animal biodiversity, or human health. The rising widespread consumption of animal products has been strongly correlated with unsustainable practices. The primary objective of this study, however, is to examine the intake of ultra-processed foods (UPFs). Reduce the hazards connected with food serving as a source of infections in order to guarantee that customers around the world have access to nutritious food. Foodborne infections have the potential to obstruct socioeconomic growth due to the high frequency of infectious disorders connected to food transmission in low-income communities. They also contribute significantly to death and morbidity. Due to the broad expansion of PFs and the disintegration of traditional cooking traditions, there is rising fear that the availability of delicious, accessible, and economical food would inevitably compromise healthy eating habits. UPFs frequently include products that are marketed as being healthy, such as those that are light, vegan, organic, or gluten-free. Not only "junk food," are some foods also deemed healthy. UPFs are defined by the use of highly processed / purified "cosmetic" components and/or additives that are meant to either improve or degrade palatability attributes; such as Flavour, fragrance, colour, and texture. This review's objective is to assess the research focusing at the connection between levels of UPF consumption and health effects while also considering the extent of food processing.
This called for an extensive review of the body of existing research, the integration and interpretation of data from multiple study types, demographics, and evaluations of health outcomes and dietary recommendations and quality appraisal.

Keywords: Ultra-processed food, additives, health outcomes, dietary patterns, NOVA classification

Introduction
Foods that have undergone industrial processing have become more prevalent globally in recent year (Fardet, A, 2016) [4]. "Ultra-processed" is defined as "industrial formulations made primarily from substances extracted from foods (such as oils, fats, starch, and proteins) derived from food constituents (such as hydrogenated fats and modified starch) or synthesized in laboratories from food substrates or other organic sources (such as flavour enhancers, color's, and various food additives used to make the product hyper-palatable)." In addition to browning, it may cause the Maillard reaction, heterocyclic amines, and polycyclic aromatic hydrocarbons to form, which are dangerous chemicals that can be found in processed meat. Foods replace nutritive foods in the diet, give the body risk nutrients, and, as byproducts of industrial processing, may have odd physical structures or chemical compositions that raise the possibility of unfavorable health impacts (Monteiro, C. A. *et al*. 2018) [7]. Population-based studies show that ultra-processed foods are frequently high in sugar, salt, unhealthy fats, and energy density but low in dietary fiber, protein, vitamins, and minerals. Experiments show that foods with a high level of processing have low satiety potential, high glycemic reactions, and select microbes that promote various inflammatory diseases in the gut (Fardet. A, 2016) [3]. Cross-sectional and longitudinal studies have shown that an increase in the dietary share of ultra-processed foods lowers the nutritional quality of the overall diet and raises the risk of obesity, hypertension, coronary and cerebrovascular diseases, metabolic syndrome, and diabetes(Baraldi, L.G. *et al*. 2018) [1].

Classification
A practical way to identify if at least one component from the NOVA ultra-processed food group is included in the ingredient list of a product is a useful technique to determine whether it is ultra-processed. Four categories are suggested by the NOVA food

classification: minimally processed or unprocessed foods, processed culinary components, processed foods, and ultra-processed meals and beverages (UPFDs) (Monteiro, C. *et al*. 2018) [6]. The NOVA classification system was the first to introduce the phrase "ultra-processed" (Dahl, W. J. *et al*. 2020) [2]. The epidemiologic approach that currently depends on connecting nutrient intakes to chronic disease and then identifying foods that warrant inclusion in public health nutrition initiatives offers minimal advantage over the NOVA classification. In high-income nations like the United States, Canada, and the United Kingdom, as well as between one-fifth and one-third in middle-income nations like Brazil, Mexico, and Chile, ultra-processed foods already make up more than half of all dietary energy consumed. In high-income countries, the average yearly increase in sales of these products is around 1%, but in middle-income countries, it might reach 10% (Monteiro, C. A. *et al*. 2020) [9].

Food additives

Food additives are divided into three categories by the WHO and FAO and can be either natural, chemical, or derived from plants or animals. Flavoring agents, additional additions, and prepared enzymes (Hall, R. L.1973). The intensity of the negative health impacts depends on the elements that led to the exposure. The following elements are especially crucial:

- Type of chemical
- Chemical dosage or amount (the amount or level of a chemical to which a person was exposed)
- Time spent being exposed (how long did exposure occur)
- Exposure duration (how many times the person was exposed)

Age, gender, genetics, pregnancy, and other health characteristics are the main variables that affect a person's vulnerability to exposure and negative health impacts. The kind, duration, and presence of hazardous chemicals in food are all variables that affect negative health impacts. A lot of times, allergic responses are caused by the additives added to products to increase their marketability. Most food additives have the potential to result in headaches, nausea, fatigue, and breathing problems. Examples of hypersensitive reactions include gastrointestinal illnesses, nervous system disorders, respiratory issues, and skin conditions. Although toxins cannot be totally avoided, they can be minimized by using organic, environmentally friendly, and less harmful alternatives (Marrón-Ponce *et al*. 2018) [5].

Food and human food patterns change with modern life style

Diets started to alter in the 1970s as people began to depend more on processed foods, dine out more frequently, and consume more edible oils and sugar-sweetened beverages (Rivera, *et al*. 2004) [14]. Early in the 1990s, low- and middle-income countries began to notice these changes, but it wasn't until the global rise in diabetes, hypertension, and obesity that they were fully appreciated. (Popkin, B. M. *et al*. 2012) [13].The primary reason for this worry has been the rise in obesity rates brought on by our obesogenic environment, which is characterized by a wide range of easily accessible, affordable, high-calorie foods a substantial section of the world's population, especially young people and children (Swinburn, Egger & Raza, *et al*. 1999) [16]. In recent years, the eating habits of adolescents have been a significant cause of worry. As a result, extensive policy and intervention efforts have been made to persuade teenagers to eat more fruits and vegetables and less candy and soft beverages. The HBSC study's objective is to evaluate patterns of health behaviour and lifestyle. In 2019, Lawrence, M. A., and Baker, P. I. The outcome variables were subcategorized in a HBSC study to evaluate whether or not students consumed fruit, vegetables, sweets, and soft drinks on a daily basis (Fismen *et al*. 2014) [11] Approximately 1.5 billion persons worldwide were predicted to be overweight or obese in 2008. According to one projection based on our research of recent statistics, there would be 1.12 billion obese individuals and 2.16 billion overweight adults worldwide in 2030 (Kastorini, C. M., *et al*. 2011) [12].

Composition of ultra-processed food & ultra-processed food in industry

To more fully understand the impact of UPF consumption on human health, analyses the link between consumption of UPF and health outcomes. An evaluation of the nutritious profile of ultra-processed foods (UPFs) sold in Italy was done using three front-of-pack labelling (FOPL) systems France employed. There were 124 different items in the study's fourteen food product categories. As a result, less than one-third of the food items had fat (23%), saturated fat (31%), sugars (23%), or salt (13%) levels exceeding MTL. On the other hand, when it came to total fats (65%), saturated fats (29%), sugars (31%), and salt (74%), foods were most usually categorized as medium (or "amber") (Lorenzoni, G. *et al*. 2021) [19]. No food was below the green line after accounting for all nutrients. The data demonstrate that increased UPF consumption has a detrimental effect on the nutritional quality of diets, as it was linked to higher levels of free sugars, total fats, and saturated fats, as well as lower levels of fiber, protein, potassium, zinc, and magnesium, as well as vitamins A, C, D, E, B12, and niacin. Red meat, grains, and chicken had significantly higher contributions to total energy consumption (almost 8% E) for UPFs at the 15% E level, and the biggest negative correlations were detected for these foods. These foods also had a larger drop (approximately 0.1% E) for each 1-point rise in % E from UPF consumption (Veronese, N. *et al*. 2018) [21]. However, the NOVA literature does not fully recognize the function of these "nutrients to limit." The decreased nutritional content of "processed" and "ultra-processed" foods is instead attributed to food processing. The American Dietary Guidelines have long advised against consuming saturated fat, added sweets, and sodium (Drewnowski *et al*. 2020) [22].

Impact of food processing on antioxidants found in vegetable oils, fruits and vegetable

Food protection from oxygen is the main goal of antioxidant protective technologies. Benzoates, sorbets, metabisulphite, and polyphosphates have all been shown to be effective at preserving the quality of cooked fruits and vegetables and preventing spoilage.

Antioxidant preservatives are often used to lengthen the shelf life of fruits and vegetables. When fruits and vegetables are prepared, a number of oxidative activities, such as the removal of electrons from atoms or molecules

and the production of an oxidized form, may take place. These events result in browning reactions, flavour or odour loss or changes, texture changes, and nutritional value loss due to the degradation of vitamins and essential fatty acids (Loliger, J. *et al*., 1996) [23]. Oxidation leading to overt rancidity is the second most significant factor in food decomposition after microbiological spoilage. Antioxidants are typically considered to be tools for combating oxidation. As their importance in preserving health has grown, antioxidant retention throughout food preparation and storage has become more crucial (Dziezak, J.D.1986) [24].

Children and ultra-processed food

A foetus, kid, or adolescent is recognized as the world's future. They are therefore required to keep up their state of health. It might be argued, however, that children are more adversely affected by ultra-processed foods than adults are. WHO recommends that a fetus's main source of nutrients come from breast milk? But giving children foods that have undergone extreme processing reduces their body's resistance to chronic illnesses, affects their dietary habits, and worsens obesity and overweight disorders (Vedovato, G. M. *et al.* 2021) [37]. Based on their lifestyle, all of these factors will increase waist circumference, cardiovascular issues, and cholesterol levels, which will hinder cell development. Cell development might slow down or stop in adolescents due to their curiosity and lifestyle-related physical activity, which can interfere with their hormonal changes. It comes down to the reality that eating foods with a high level of processing will harm their health at any stage of life (Sparrenberger, K *et al*. 2015) [36].

Industry movement towards ultra-processed food

The movement of industries towards the manufacturing of ultra-processed food can be observed due to the increase in the lifestyle changes in the consumers, increased income and the working hours of the people is increasing rapidly making the demand for the ultra-processor to grow exponentially.

Another reason observed is that the ultra-processed food can be preserved way longer than the normal food which reduces the burden of repeated shopping or in case of travelling when people are supposed to travel for hours without any mode to obtain foods for consumption. These ultra-processed foods can also be viewed to be used by the sailors, soldiers, the military people and the armed forces who are no duty always and might not be able to receive the aid on-time always will preserve the food they have for weeks or months for their consumption in time of requirements (Louzada, M. L. D. C., *et al*. 2015) [25]. The main reason for the production of the ultra-processed food is the production cost which is very low and also the substances used for the process of production of ultra-processed food can be obtained easily and they can also be used for a longer time reducing the overall manufacturing cost of the products and the gain of the profits to increases in bounds. It is also fact that would help in the consumption of some of the foods in the form ultra-processed food irrespective with the ongoing seasons, for example pickling of the mango in the summer can be consumed even during the winter and rainy seasons when mangoes are not available for the production and this is also the case with other products. Hence the overall lifestyle, livelihood, food system, urbanization and the income pattern are the main causes for the mass production of the ultra-processed foods (Mialon, M., and da Silva Gomes, F. *et al*. 2019) [40].

Effects of ultra-processed food consumption on anthropometric measurements and glucose profiles

Childhood exposure to known risk factors for obesity and insulin resistance, such food, is associated with the emergence of these diseases. High levels of food processing have come under scrutiny as a dietary component (Costa *et al.* 2019) [26]. In one study, 307 youngsters from So Leopoldo, Brazil, who had low socioeconomic status took part in a follow-up of a randomized controlled trial. At ages 4 and 8, anthropometric data from preschool through grade school students were collected. According to analyses of nationally representative dietary surveys conducted in high- and upper middle-income countries, the consumption of ultra-processed foods has a detrimental effect on diets' nutritional quality because these foods are nutritionally unbalanced when compared to foods that aren't ultra-processed. Ultra-processed foods usually have higher levels of unhealthy fats, free sugar, and sodium compared to unprocessed or minimally processed foods, as well as a greater glycemic response and a decreased capacity for tolerance. A higher risk of obesity, overweight, and diseases including cancer and hypertension as well as a higher proportion of processes in the human micro biome connected to inflammation have all been linked in studies to eating ultra-processed foods (Chen, X., *et al.* 2020) [34]. But very few studies have examined the connection between consuming highly processed food and childhood health issues. Given the findings of studies suggesting that the dysmetabolic effects of ultra-processed meals may even start in childhood, the pediatric population may be at risk for non-communicable diseases [27].

Microbial risk aspect

A wide variety of food products, including low, medium, and high viscosity liquids, some containing particles, can be thermally processed. Therefore, it is crucial to carefully analyze how these elements may affect microorganisms' ability to withstand heat while developing a product. In recent years, customer demand - particularly for convenience and rapidity of food availability - has changed how food products are designed Walsh *et al*. (2018) [41] and Casani *et al*. (2005) [42] nearly the past ten years, there has been an average reduction in meal preparation time of over 50%. This has been explained by the hectic lifestyles of contemporary culture. Salmonella spp. are known to develop at the lowest pH levels among vegetative pathogens; nevertheless, a study by Chung and Goepfert (1970) [38] found that the acidulant used had a significant impact on the limiting pH (Nicoli *et al*. 1997) [35]. The microbes that often predominate in food can use the nutrients there most readily. At every stage of the food production chains, from farm to fork, the microbial interactions with food products and processes need to be examined. The microbes found in food processing facilities may be a source of foodborne pathogens and microbial spoilers that can contaminate processed food products, raising the microbiological hazards connected with that particular food product (Feye *et al*. 2020) [39].

UPF and its adverse health outcome

It has been demonstrated in recent years that an imbalanced

diet is the primary contributor to NCDs. High levels of free sugars, unsaturated fats, proteins, and Na energy density products are present together with decreasing levels of proteins, fibers, and nutrients in the growing consumption of UPF (Elizabeth, L. *et al*. 2020) [34].

Additionally, it contains additive compounds to enhance the items' appeal. In order to increase the product's appeal, it could additionally contain derivatives and additives. Additionally, it is clear that ultra-processed food consumption as a diet has spread globally. Overconsumption of UPF can alter the microbiota of the gut and levels of serum C- reactive protein, as well as lead to obesity, cardiovascular disease, hypertension, and several types of cancer. This form of food processing results in genotoxicity and carcinogenicity. The link between UPF consumption and its impact was examined by Rauner *et al*. and found to be proportionate. The figures shown above make it quite evident that increased UPF consumption would result in higher death rates, especially among the population of the UK (Gibney M. J. *et al*., 2017) [32].

Health outcomes: A narrative review

Three ecological studies were found: Juul *et al*. examined agricultural food data at the national level and sampled about 4000 families. They discovered that trends in Sweden's food energy availability had increased between 1980 and 2010, along with a 142% increase in the amount of UPF consumed. Obesity prevalence grew in males (4.5% to 11%) and women (5% to 10%), closely mirroring a growth in the share of food and energy purchases from UPF. Overweight prevalence increased in men (from 35% to 56%) and women (26% to 39%). Six cross-sectional studies using nationally representative populations were conducted. Canella *et al*. discovered that the average BMI and prevalence of being overweight or obese in Brazil were directly correlated with the household energy availability of UPF (bought food items translated to kcal/day). The frequency of excess weight increased from 34.1% to 43.9% and the prevalence of obesity increased from 9.8% to 13.1% when UPF intake increased from Quartile 1 to Quartile 4. Four research used non-nationally representative samples and were cross-sectional in nature. Silva *et al*. evaluated 8977 active and retired Brazilian civil personnel between the ages of 35 and 62. According to their findings, people with greater energy intake quartiles had higher BMI and waist circumference as well as higher likelihood of being overweight (BMI 25-30) obese, having an increased waist circumference, or having a severely increased waist circumference.

Julia *et al*. investigated 74,470 people in a web-based Nutri-Santé cohort in France. Intake of UPF was measured by percent weight by quartiles, and it was discovered that UPF was linked to obesity and overweight (BMI 25-30) as well as energy weighted quartiles. (Pagliai, G. *et al*., 2021) [33].

Conclusion

Ultra processed foods are considered to be the foods which are heavily manipulated with the addition of extra ingredients for its processing. They are basically the fourth class of foods under the NOVA food classification table which places weight on the percentage of nutrients included in the food. As discussed above it can be viewed that there are many types of food additives that have been added to the food for Ultra Processing which inversely affects the health of the person. Due to the rapid urbanization and the movement of people from rural to urban areas there is a steep change in the lifestyle of the people along with their working conditions, income, education level which is consuming most of their time leaving them with lethargic condition to cook food or to shop for the ingredients leading to the increased purchase of the Ultra processed food and industries are also viewed to be increase in their manufacturing rate to meet the needs of the consumers and to mainly increase their own profits. Every coin has two faces the same where the Ultra processed food also has its own merits and demerits. Merits include the profit gaining method of the industries and getting readymade foods for consumption in times of needs for the consumers. But compared to the merits, demerits has to be highly focused as it always leads to the chronic diseases and has adverse effects on human health leading to obesity, overweight, hypertension, cardiovascular diseases and also cancer. It might also affect the immune system and lead to the growth retardation in cases of fetus. Hence the consumption of ultra-processed food has to be highly reduced and various plans has to be initiated to educate people regarding the effects of the consumption.

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