ผลกระทบของการบริโภคอาหารแปรรูปชั้นสูงต่อสุขภาพ: การทบทวนวรรณกรรม

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บทคัดย่อ

บทความวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาทบทวนวรรณกรรมเกี่ยวกับผลกระทบของการบริโภคอาหารแปรรูปชั้นสูงต่อสุขภาพ โดยค้นหาข้อมูลผลการวิจัยจากฐานข้อมูล PubMed, Scopus, Mendeley, Web of Science และ Google Scholar ครอบคลุมระยะเวลาตั้งแต่ปี พ.ศ.2563 – 2567 โดยใช้คำค้นหา เช่น “อาหารแปรรูปขั้นสูงกับสุขภาพ”, “ผลกระทบของอาหารแปรรูปต่อสุขภาพ”, “บริโภคอาหารแปรรูปกับผลต่อสุขภาพ” และคัดเลือกวารสารที่เกี่ยวข้องโดยระบบการจำแนก NOVA เป็นระบบการจำแนกอาหารที่ถูกพัฒนาขึ้น โดยนักโภชนาการและนักวิจัยด้านสาธารณสุข เพื่อการวิเคราะห์การประมวลผลอาหารและผลกระทบต่อสุขภาพ

ผลการวิจัย ชี้ให้เห็นว่า UPF ส่งผลเสียต่อสุขภาพหลายด้าน ดังนี้ การเพิ่มความเสี่ยงโรคอ้วนและภาวะน้ำหนักเกินทั้งในผู้ใหญ่และเด็ก การเพิ่มความเสี่ยงโรคเบาหวานชนิดที่ 2 โดยเฉพาะในผู้ใหญ่ การเพิ่มความเสี่ยงโรคระบบไหลเวียนโลหิต เช่น โรคหัวใจขาดเลือก โรคหลอดเลือดสมอง และโรคความดันโลหิตสูง ทั้งในผู้ใหญ่และเด็ก การเพิ่มความเสี่ยงโรคลำไส้อักเสบโดยเฉพาะในผู้ชาย การเพิ่มความเสี่ยงโรคมะเร็ง เช่น มะเร็งเต้านมซึ่งเกี่ยวกับฮอร์โมนเอสโตรเจน การเพิ่มความเสี่ยงผลกระทบต่อสุขภาพหญิงตั้งครรภ์ การเพิ่มความเสี่ยงต่อผลกระทบทางสุขภาพจิต เช่น ภาวะซึมเศร้าและวิตกกังวล และลดปริมาตรเนื้อเยื่อสีเทาในสมองบางส่วน โดยเฉพาะในผู้ที่มีภาวะอ้วน

สรุปผลการวิจัย การบริโภค UPF ส่งผลเสียต่อสุขภาพโดยรวม ควรลดการบริโภค UPF หันมาบริโภคอาหารที่ผ่านการแปรรูปน้อยหรือไม่ผ่านการแปรรูป เช่น ผัก ผลไม้ ธัญพืช ถั่ว โปรตีนจากธรรมชาติ

Keywords: อาหารแปรรูปชั้นสูง, สุขภาพ, โรคเรื้อรัง, ผลกระทบทางสุขภาพ

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Impact of Ultra Processed Food (UPF) Consumption on Health: A Literature Review

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ABSTRACT

This research article aims to review the literature on the impact of ultra-processed food (UPF) consumption on health. Studies conducted between 2020 and 2024 were sourced from databases such as PubMed, Scopus, Mendeley, Web of Science and Google Scholar using search terms like "ultra-processed food and health," "health impacts of processed food. " and "processed food consumption and health effects". The NOVA classification system, developed by nutritionists and public health researchers, is a framework designed to categorize foods based on the extent and purpose of their processing. It serves as a valuable tool for analyzing food processing levels and their implications for health outcomes.

The findings indicate that UPF consumption adversely affects health in several ways. These include increased risk of obesity and overweight in both adults and children, heightened risk of type 2 diabetes (particularly in adults), and elevated risk of cardiovascular diseases (including coronary heart disease, stroke, and hypertension) in both populations. Furthermore, UPF consumption is associated with a significant increase in the risk of inflammatory bowel disease (especially in men) and certain cancers (such as estrogen-related breast cancer). Pregnant women are also at increased risk of health complications. Additionally, UPF consumption is linked to a reduction in the volume of grey matter in certain brain areas, particularly in individuals with obesity.

In conclusion, UPF consumption has a detrimental effect on overall health. To mitigate these risks and promote well-being, it is recommended to reduce the intake of UPFs and prioritize a diet rich in minimally processed or unprocessed whole foods such as vegetables, fruits, whole grains, nuts, and natural sources of protein.

Keywords: Ultra-processed food, health, chronic diseases, health impacts

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Introduction

In the contemporary era, populations around the world are increasingly leading fast-paced lives, prioritizing convenience and efficiency. As a result, ultra-processed foods (UPFs) have become a significant component of modern diets globally. These foods undergo extensive industrial processing and often contain additives such as preservatives, artificial colors, and flavor enhancers to improve their appeal and extend shelf life. While UPFs offer convenience, numerous studies have highlighted their association with chronic health conditions, particularly obesity and type 2 diabetes, which are rising at an alarming rate both globally and in Thailand.[1,2]

The World Health Organization (WHO) reported in 2023 that over 1.9 billion adults worldwide are overweight, with more than 650 million categorized as obese. This trend is strongly linked to the increased consumption of UPFs.[3] Additionally, type 2 diabetes affects over 462 million individuals globally, with higher prevalence observed in both developed and developing countries.[4] In Thailand, data from the Ministry of Public Health in 2021 highlighted that 37% of the population is overweight, while 9.6% meet the criteria for obesity. Urban consumers of UPFs are at a higher risk compared to their rural counterparts.[5] Type 2 diabetes prevalence is also escalating in Thailand, affecting approximately 8.5% of the population, equating to over six million individuals in 2021.[4]

The increased consumption of UPFs reflects a shift in lifestyle patterns, emerging as a significant factor contributing to various health issues. This underscores the critical need for research and policy measures aimed at mitigating the adverse impacts associated with the consumption of such food products.

Objective

This study aims to review the literature on the impact of ultra-processed food (UPF) consumption on health.

Principles Concepts and Theory

The NOVA food classification system, devised by nutritionists and public health researchers, categorizes foods into four primary groups based on the extent and purpose of food processing to analyze the impact of food processing on health. [6,7] The details are as follows:

Group 1: Unprocessed or Minimally Processed Foods (MPF)

Group 1 encompasses foods that have been harvested directly from nature and have undergone minimal or no processing. These foods are often categorized as "natural" or "whole" foods. Examples of Group 1 foods include fruits, vegetables, legumes, grains, nuts and seeds, eggs, milk, and fresh meat.

Group 2: Processed Culinary Ingredients (PCI)

Group 2 encompasses substances derived from Group 1 foods or directly from nature through processing methods such as pressing, grinding, milling, salting or fermentation. These substances include oils, fats, sugars, salts and other extracts from foods, primarily used for flavor enhancement and culinary applications.

Group 3: Processed Foods

Group 3 encompasses foods that have undergone further processing and often contain added ingredients, preservatives, and stabilizers. Examples of Group 3 foods include canned vegetables, canned fruits in syrup, fresh bread, cheese, and prepared meats.

Group 4: Ultra-processed Foods and Beverages

Group 4 encompasses highly processed foods and beverages that have undergone extensive transformations and often contain a combination of ingredients from Groups 2 and 3, along with additional additives. These products are typically designed to be appealing in taste, color, aroma, and texture, offering convenience and extended shelf life. They often include a multitude of chemical ingredients, such as added sugars, oils, fats, salts, flavorings, colorings, and sweeteners. Examples of Group 4 foods and beverages include soft drinks, snack foods, instant noodles, candy, processed meats (e.g., bacon, hot dogs), ready-to-eat meals, frozen pizzas, sugary cereals, and sweetened coffee drinks.[8]

The NOVA food classification system serves as a valuable tool for understanding the processing levels of foods and their potential impact on health. By emphasizing the consumption of minimally processed foods from Groups 1 and 2, the system aligns with recommendations for promoting well-being and reducing the risk of chronic diseases.

Research Methodology

Study Design: A literature review on the impact of ultra-processed food (UPF) consumption on health.

Objective Setting of the Research: To conduct a comprehensive literature review on the impact of ultra-processed food (UPF) consumption on health. The review aims to synthesize existing research and provide a clear understanding of the associations between ultra-processed food consumption and various health outcomes among the general population.

Data Sources: This research will utilize data from reliable academic databases including PubMed, Scopus, Mendeley, Web of Science, and Google Scholar. The search will focus on research articles related to the impact of ultra-processed food consumption.

Literature Search: To search for articles, use search terms such as "ultra-processed foods and health," "impact of processed foods on

health," and "health effects of ultra-processed food consumption" in the specified database. Adjust the search terms and use Boolean operators like AND, OR, and NOT to obtain more specific and comprehensive results.

Selection Criteria for Articles: A total of 100 articles were retrieved based on the search terms under specified conditions, comprising the following sources: PubMed (25 articles), Mendeley (25 articles), Scopus (18 articles), Web of Science (17 articles), and Google Scholar (15 articles). After undergoing a quality assessment process, 50 articles met the inclusion criteria and were selected to ensure the reliability and comprehensiveness of information regarding the impact of ultra-processed food consumption on health. The inclusion criteria for article selection were defined as follows:

Inclusion Criteria:

1.Research articles published in peer-reviewed academic journals between 2020 and 2024.

2.Articles that investigate food classification using the NOVA system, a widely recognized framework in the fields of nutrition and public health.

3.Studies focusing on the relationship between the consumption of ultra-processed foods and health outcomes.

4.Articles containing clear and appropriate statistical data and research methodologies.

A total of 21 research articles met the selection criteria.

Exclusion Criteria:

1.Research studies not published in peer-reviewed journals.

2.Studies with unclear research methodologies or lacking quantitative data to support their conclusions.

3.Articles focusing on specific population groups, such as children under five years old or specialized patient cohorts, which are not generalizable to the broader population.

4.Reports or articles that did not employ the NOVA system for analysis. A total of 29 articles were excluded based on these criteria.

Flowchart of the Article Selection Process for Data Analysis

1.Articles Initially Identified: A total of 100 articles were retrieved during the search process.

2.Articles Assessed for Quality: 50 articles underwent quality screening and evaluation.

1. Articles Meeting Inclusion Criteria: 21 articles were selected based on the established inclusion criteria.
2. Articles Excluded: 29 articles were excluded due to not meeting the specified criteria.
3. Articles Included for Data Analysis: A total of 21 articles were finalized for data analysis.

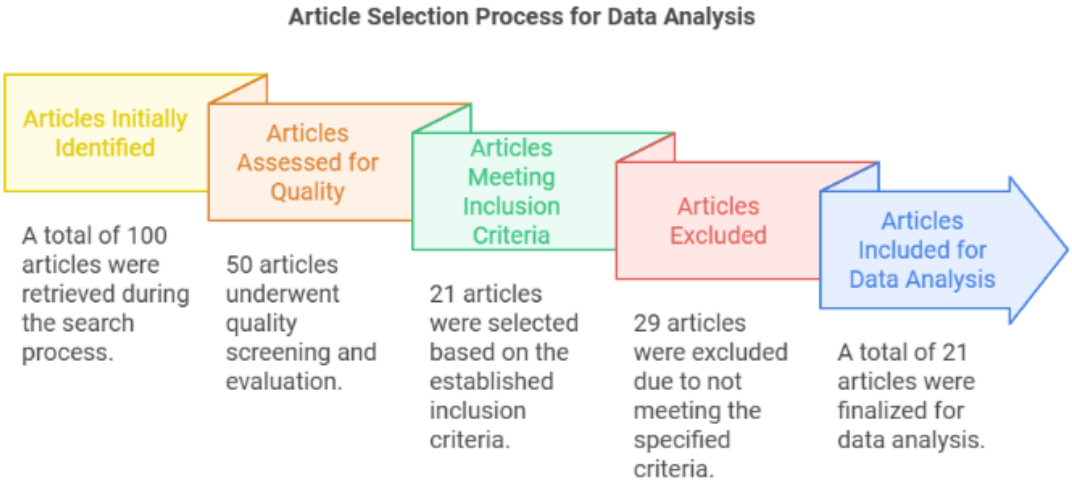

Figure 1 Flowchart of the Article Selection Process for Data Analysis

Credibility Assessment of All 21 articles

1. Peer-reviewed status: All 2 1 articles were selected based on stringent inclusion criteria and quality evaluation tools such as the Newcastle-Ottawa Scale (NOS) and AMSTAR, ensuring robust methodological rigor.

2. Database reliability: The majority of the articles (57%) were sourced from PubMed and Mendeley, two highly reputable databases widely recognized for their credibility and quality in academic and scientific research.

3. Publication timeline: All articles were published between 2020–2024, ensuring that the findings are current and relevant.

4. Consistency with inclusion criteria: Only articles with clear methodologies, robust statistical data, and strong relevance to ultra-processed foods and health impacts were included.

Data Extraction & Conceptual Framework: The extraction process focuses on relevant data from selected articles, including information on the studied population, characteristics of ultra-processed foods (UPF) analyzed, and their associated health impacts. This conceptual framework illustrates the relationship between UPF consumption and health outcomes, with findings categorized into three key domains: physical health, specific diseases, and mental health. The analysis prioritizes evidence-based findings to establish the connections, synthesizing the implications of UPF consumption on these domains. Finally, a comprehensive conclusion is drawn from the body of evidence reviewed.

Data Analysis

Employ content analysis to synthesize study findings and identify relationships between ultra-processed food consumption and health effects.

Conclusion and Discussion

Summarize the literature review findings, discuss key discoveries, research strengths and limitations, future research directions, and strategies to address health issues associated with ultra-processed food consumption.

Results and Discussion

This conceptual framework synthesizes research findings on the relationship between the consumption of ultra-processed foods (UPFs) and their multifaceted health impacts, categorized systematically based on academic principles and key findings. The framework hierarchically organizes these impacts, starting with physical health outcomes, and specific disease risks, and extending to mental health implications. Detailed analyses include the following dimensions:

1. Ultra-Processed Foods (UPF) and Obesity

The consumption of ultra-processed foods (UPFs) has been extensively studied as a significant factor linked to obesity in the general population. Multiple studies support this finding, albeit with variations in detail and population characteristics. For instance, a Canadian study involving 13,608 adults reported that high UPF consumption increased the risk of general obesity by 1.31 times compared to low consumption levels.[8] Similarly, research conducted in South Korea, which examined 8,097 adults, found that high UPF consumption was associated with a 1.34-fold increased risk of abdominal obesity.[9] These findings reveal a consistent relationship between UPF intake and obesity among adults, despite differences in cultural contexts and dietary behaviors.

Among younger populations, a study of 364 children in Brazil demonstrated that high UPF consumption doubled the risk of developing "normal-weight obesity" (NWO), a condition characterized by normal body weight but disproportionately high body fat levels.[10] This highlights that UPF impacts extend beyond weight gain to include imbalances in body fat distribution.

However, some research presents divergent observations, such as regional or population-specific variations in the relationship between UPF consumption and body mass index (BMI). Furthermore, the proportion of energy derived from UPFs appears to influence obesity prevalence differently. For instance, obesity prevalence rates of 35.4% for general obesity and 30.2% for abdominal obesity were reported when UPFs accounted for 17.9% of total energy intake.[9] In

In conclusion, while most studies align in suggesting that UPF consumption is associated with increased obesity risk, variations in population characteristics and

cultural dietary patterns underscore the complexity of this relationship across different contexts.

2. Ultra-Processed Foods (UPF) and Type 2 Diabetes (T2D)

Type 2 diabetes (T2D), a significant global health concern, has been strongly associated with high consumption of ultra-processed foods (UPF). Numerous studies have corroborated this relationship, offering insights into the similarities and differences in their findings and contexts. For instance, a study involving 13,608 Canadian adults reported a 37% increase in the likelihood of developing T2D and a relative risk (RR) of 1.37 among high UPF consumers.[8] This aligns with a 10-year longitudinal study in China involving 12,849 participants, which found that the highest UPF consumers exhibited a 1.21–1.49 times greater risk of T2D, depending on consumption levels.[11]

Similarly, research conducted in the United Kingdom revealed that T2D risk increased by 1.12 times for every 10-unit increase in UPF intake.[12] However, notable differences were observed in South Korea, where studies focused on specific types of UPF, such as ham, sausages, and carbonated beverages. Here, the highest UPF consumers faced a 1.34-fold increased risk of T2D.[13] Moreover, geographic disparities were evident; for example, older adults in urban areas consumed significantly more UPF (146.1 g/day) than those in rural regions (126.6 g/day), likely reflecting differences in lifestyle and urban convenience.[14]

The convergence of findings underscores the critical role of UPF consumption in elevating T2D risk across diverse populations. However, variations in food types, dietary behaviors, and geographic contexts highlight the importance of cultural and lifestyle factors in determining T2D risk. These findings emphasize the need for tailored public health policies and further research that considers these multifaceted influences to address T2D effectively.

3. Ultra-processed foods (UPF) and cardiovascular disease

Hypertension: A growing body of evidence highlights a strong negative association between UPF consumption and cardiovascular health. One study indicates that adults consuming high levels of UPFs are 60% more likely to develop hypertension, with an odds ratio (OR) of 1.60 compared to those with lower UPF intake.[9] Among women, another study revealed a 1.39-fold increased risk of hypertension linked to UPF consumption.[15] These variations may reflect differences in dietary behaviors and health practices across populations.

Cardiovascular Health (CVH): The relationship between UPF consumption and

CVH appears robust. Studies confirm a positive correlation between the consumption of minimally processed foods (MPFs) and improved CVH. Conversely, UPF intake is consistently associated with adverse CVH outcomes, particularly among women and older adults.[14] However, conflicting findings have emerged in specific subgroups, such as women, where the impact of UPFs on cardiovascular health remains inconclusive.[16]

Coronary Heart Disease (CHD) and Stroke: Increased UPF consumption is linked to heightened risks of CHD and stroke. A 10% rise in daily energy intake from UPFs corresponds to a 1.13-fold increase in the risk of non-fatal CHD, a 1.33-fold increase in severe CHD, and a 1.40-fold increase in stroke risk.[17] Additionally, children and adolescents consuming high UPF levels face a significantly elevated CVD risk, with odds up to 3.77 times higher.[18] These findings underscore the critical need for strategies to reduce UPF consumption across all age groups.

Conclusion Despite some variations in results due to differences in study populations, methodologies, and dietary contexts, the majority of research supports the conclusion that high UPF consumption elevates CVD risk. Further research is essential to develop tailored prevention strategies that address the unique needs of diverse populations.

4. Ultra-Processed Food and Inflammatory Bowel Disease: IBD

The association between ultra-processed food (UPF) consumption and inflammatory bowel disease (IBD) reveals consistent findings in key aspects across studies, though differences emerge depending on population characteristics and study context. A longitudinal study of 185,849 participants in the United Kingdom, with a mean follow-up of 9.84 years, found that high UPF consumption significantly increased the risk of Crohn's Disease (CD) by 1.94 times and Ulcerative Colitis (UC) by 1.39 times. Furthermore, patients with the highest UPF consumption exhibited a 4.06-fold increase in surgical requirements compared to those with lower UPF intake, indicating a clear relationship between UPF consumption and IBD severity in large populations.[19]

Conversely, a study conducted in a tertiary care hospital involving 242 IBD patients demonstrated a positive association between UPF consumption and disease exacerbation, with a 2.24-fold increased risk of active disease. In contrast, unprocessed food consumption was inversely associated with disease activity. This finding corroborates the UK study while adding a preventive dimension, emphasizing the protective role of

natural foods.[20]

When stratified by gender, research on 1,083 men and 8,826 women (HPFS, NHS, NHS II) found that processed meat and meat substitute consumption increased IBD risk by 1.07 times per serving among men, while no association was observed among women. These highlights potential gender differences in risk factors for IBD.[21]

Conclusion while these studies collectively support the hypothesis that UPF consumption elevates IBD risk, the extent of risk and associated factors vary by population and study context. Effective prevention and management strategies should therefore consider these diverse factors to address IBD comprehensively.

5. **Ultra-Processed Food and Breast Cancer**

Consumption of ultra-processed foods (UPFs) has been positively associated with an increased risk of breast cancer, as confirmed by multiple studies across various populations. For instance, one study reported that UPF consumption was associated with a 1.93-fold increase in the risk of overall breast cancer, with an even higher risk (2.44-fold) observed for estrogen-related breast cancer subtypes.[22] Furthermore, findings from Latin America highlighted that high UPF consumption among young women significantly elevated breast cancer risk, particularly with the intake of high-calorie UPFs such as sweet and salty snacks, breakfast cereals, and fast food.[23]

However, variations in risk levels have been noted depending on demographic contexts and dietary behaviors. For example, a European study indicated that a 10% daily increase in UPF consumption was associated with a comparatively modest 1.12-fold increase in breast cancer risk. These differences may stem from variations in the types of UPFs consumed or population-specific nutritional profiles.[6] Similarly, research from China observed a 1.37-fold increase in breast cancer risk among individuals with the highest UPF consumption levels, with sugary beverages and cakes identified as key contributors.[11]

Conclusion while these studies collectively support the hypothesis that UPF consumption heightens breast cancer risk, the magnitude of risk and the specific UPF categories implicated vary across different populations. Further comparative research across regions may provide deeper insights into the complexity of these risk factors and their interactions.

6. Ultra-Processed Food and Pregnant

Research Findings on Ultra-Processed Food (UPF) Consumption Among Pregnant Women.

Similarities in Findings

1. Proportion of Energy from UPF: Research indicates an increase in the proportion of energy derived from UPFs during pregnancy. One study reported an increase from 28.9% pre-pregnancy to 33% during pregnancy, [24] aligning with another study that found the average energy contribution from UPFs in pregnant women to be approximately 32.1%.[25] These findings suggest that the increased UPF consumption during pregnancy may be driven by the need for convenient and readily available food options.

2. Association with Individual Factors: Multiple studies have consistently reported that older women tend to consume fewer UPFs.[24,25] Additionally, women with higher levels of education or better socioeconomic status show a tendency to consume less UPF, likely due to greater health awareness in these groups.

Differences in Findings

1. Pre-Pregnancy BMI and Weight: Contrasting results have been observed regarding the relationship between pre-pregnancy BMI and UPF consumption. Some studies report that women with a higher BMI prior to pregnancy consume less UPFs[24], whereas others find that women with lower pre-pregnancy weight tend to consume more UPFs.[25] These differences may be influenced by varying dietary behaviors across population subgroups.

2. Behavioral Factors: Research on women who smoked or were physically inactive before pregnancy suggests they are more likely to consume UPFs.[25] However, other studies did not find a strong correlation between these behaviors and UPF consumption.[24]

Conclusion While these studies share similarities in identifying key factors influencing UPF consumption, variations in sample populations and study methodologies underscore the importance of contextual analysis to better understand the dietary behaviors of pregnant women in different settings and populations.

7. Ultra-Processed Food and Mental Health

Ultra-processed foods (UPFs), characterized by their convenience and widespread popularity, have been increasingly linked to deteriorating mental health outcomes, including depression, anxiety, and other psychological disorders. Comparative analysis of multiple studies enhances understanding of this critical issue.

Depression: A longitudinal study involving 183,474 participants demonstrated a significant association between high UPF consumption and an increased risk of depression, particularly in individuals with obesity, who exhibited a 1.5-fold higher prevalence of depressive symptoms compared to those with the lowest UPF intake.[2 6] Conversely, research conducted among European older adults suggested that the relationship between UPF consumption and depression may weaken when considering confounding factors such as socioeconomic status and physical activity levels.[27]

Anxiety: Several studies have reported a consistent trend where individuals with the highest UPF consumption showed elevated risks of anxiety disorders compared to those with the lowest intake.[28] This risk was more pronounced in overweight individuals. However, a study from China highlighted variability in risk depending on UPF type, with snack foods and sugar-sweetened beverages exerting a stronger influence than other categories.[11]

Brain Structure Changes: Reduced gray matter volume in brain regions such as the amygdala and frontal cortex has been observed in individuals with the highest UPF intake[2 7], correlating with symptoms of depression and anxiety. However, studies on certain older populations reported no significant structural brain changes, potentially due to the complex interactions between UPF consumption and factors such as age or genetic predispositions.[26]

Conclusion while numerous studies converge on the negative impacts of high UPF consumption on mental health, variations exist regarding the affected populations and specific food categories. Further research across diverse contexts is essential to provide a more comprehensive understanding of this relationship.

Research Summary

1. Ultra-processed foods (UPF) consumption is associated with obesity and overweight status in both adults and children.
2. Ultra-processed foods (UPF) consumption significantly increases the risk of type 2 diabetes (T2D), especially in adults.
3. Ultra-processed foods (UPF) consumption correlates with an increased risk of cardiovascular diseases (CVDs) in both adults and children, including coronary heart disease (CHD), stroke, and hypertension.
4. Ultra-processed foods (UPF) consumption is linked to an increased risk of developing inflammatory bowel disease (IBD), particularly in males, and is associated with a higher likelihood of surgery related to IBD. The association is less clear in females.

5. There is a clear association between UPF consumption and an increased risk of breast cancer, particularly concerning estrogen hormone intake.

6. Age, socioeconomic status, and pre-pregnancy body mass index (BMI) are associated with high consumption of ultra-processed foods (UPF) in pregnant women. Older age, higher education, and healthier lifestyles are associated with lower UPF consumption, while lack of exercise, smoking, multiple pregnancies, and lower pre-pregnancy weight are associated with higher UPF consumption.

7. Ultra-processed foods (UPF) consumption is correlated with an increased risk of depression and anxiety disorders, as well as a decrease in gray matter volume in certain brain regions, especially in individuals with obesity.

Acknowledgment Statement

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Limitations of the Study

1. The findings of this study may lack generalizability to populations in countries with diverse economic and cultural contexts.

2. The reliance on self-reported data introduces potential recall bias or inaccuracies, which could impact the reliability of the results.

3. The study's relatively short follow-up period limits the ability to comprehensively assess the long-term effects of consuming highly processed foods.

4. Observed effects may be confounded by variables such as physical activity, socioeconomic status, or education level, thereby reducing the precision of the conclusions.

5. Although widely used, the NOVA food classification system may not fully account for the complexity of food production processes and the nutritional value of foods in daily life.

This structured analysis highlights the need for further research to address these limitations, ensuring more robust and universally applicable findings in future studies.

Research suggestions

1. Public Health Interventions: Implement public health campaigns to raise awareness about the detrimental effects of consuming ultra-processed foods (UPF) on obesity and overweight status. These campaigns should target both adults and

children, emphasizing the importance of a balanced diet rich in whole foods.

2. Dietary Guidelines: Revise dietary guidelines to discourage the consumption of ultra-processed foods (UPF) and promote healthier food choices. Encourage the population to opt for minimally processed or unprocessed foods to reduce the risk of developing type 2 diabetes (T2D).

3. Cardiovascular Disease Prevention: Develop comprehensive strategies to prevent cardiovascular diseases (CVDs), including coronary heart disease (CHD), stroke, and hypertension, by reducing UPF consumption. This could involve implementing policies to limit the availability and marketing of UPF, as well as promoting heart-healthy eating habits.

4. Inflammatory Bowel Disease (IBD) Management: Enhance IBD management protocols, particularly among males with high UPF consumption. Provide education and support to individuals with IBD to help them make healthier dietary choices and reduce the need for surgery associated with the condition.

5. Breast Cancer Prevention: Integrate information about the association between UPF consumption and breast cancer risk into breast cancer prevention initiatives. Encourage women to limit their intake of UPF, especially those containing estrogenic compounds, to reduce their risk of developing breast cancer.

6. Prenatal Health Programs: Incorporate nutrition education into prenatal health programs to educate pregnant women about the importance of dietary choices during pregnancy. Empower women with resources and support to adopt healthier eating habits and avoid high UPF consumption, especially those with risk factors such as older age, lower education, and unhealthy lifestyles.

7. Mental Health Support: Strengthen mental health support services and resources to address the increased risk of depression and anxiety associated with high UPF consumption. Offer counseling, therapy, and mindfulness-based interventions to individuals experiencing mental health challenges, particularly those with obesity.

Reference

1. Monteiro CA, Cannon G, Levy RB, Alcocer MA, Martins AP, Popkin BM. Ultra-processed foods in the global diet, 1990-2010: ten years of progress and challenges. Adv Nutr. 2013;4(3):542S-550S. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10899807/

2. Louzada ML, Ricardo CZ, Steele EM, et al. The share of ultra-processed foods determines the overall nutritional quality of diets in Brazil. Public Health Nutr. 2021;24(1):18–26.

3. World Health Organization. Obesity and overweight. 2023. Available from:

https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.
4. International Diabetes Federation. IDF Diabetes Atlas. 10th ed. Brussels: IDF; 2022.
5. Ministry of Public Health. The health status of Thai population. Annual Report. Bangkok: MOPH; 2021.
6. Monteiro CA, Cannon G, Lawrence M, Laura Da Costa Louzada M, Machado PP. Ultra-processed foods, diet quality, and health using the NOVA classification system Prepared by [Internet].2022 Nov 8 [cited 2024 May 27];19(22). Available from:: http://www.wipo.int/amc/en/mediation/rules
7. World Health Organization. The NOVA classification of food and beverages [Internet]. 2019 [cited 2024 May 27]. Available from: https://openknowledge.fao.org/server/api/core/bitstreams/5277b379-0acb-4d97-a6a3-602774104629/content
8. Nardocci M, Polsky JY, Moubarac JC. Consumption of ultra-processed foods is associated with obesity, diabetes and hypertension in Canadian adults. Canadian Journal of Public Health [Internet]. 2021 [cited 2024 May 22];112(3). Available from: https://link.springer.com/article/10.17269/s41997-020-00429-9
9. Shim JS, Ha KH, Kim DJ, Kim HC. Ultra-Processed Food Consumption and Obesity in Korean Adults. Diabetes and Metabolism Journal [Internet]. 2023 [cited 2024 May 22];47(4). Available from: https://www.e-dmj.org/upload/pdf/dmj-2022-0026.pdf
10.Cota BC, Filgueiras M de S, Pereira PF, Juvanhol LL, Novaes JF de. Higher consumption of ultra-processed foods and a pro-inflammatory diet are associated with the normal-weight obesity phenotype in Brazilian children. Nutrition [Internet]. 2024 [cited 2024 May 22];117. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0899900723002629?via%3Dihub
11.Li M, Shi Z. Association between Ultra-Processed Food Consumption and Diabetes in Chinese Adults—Results from the China Health and Nutrition Survey. Nutrients [Internet]. 2022 [cited 2024 May 22];14(20). Available from: https://www.mdpi.com/2072-6643/14/20/4241
12.Levy RB, Rauber F, Chang K, Louzada ML da C, Monteiro CA, Millett C, et al. Ultra-processed food consumption and type 2 diabetes incidence: A prospective cohort study. Clinical Nutrition [Internet]. 2021 [cited 2024 May 22];40(5). Available from: https://www.clinicalnutritionjournal.com/article/S0261-5614(20)30693-2/abstract
13.Cho Y, Ryu S, Kim R, Shin MJ, Oh H. Ultra-processed Food Intake and Risk of Type 2 Diabetes in Korean Adults. Journal of Nutrition [Internet]. 2024 [cited 2024 May 22];154(1). Available from: https://www.sciencedirect.com/science/article/pii/S0022316623727429?pes=vor

14.Lee SJ, Cho MS. Association of ultra-processed food with diabetes and impaired fasting glucose in elderly populations (urban and rural): a cross-sectional study. Korean Journal of Community Nutrition [Internet]. 2024 [cited 2024 May 22];29(1). Available from: https://kjcn.or.kr/DOIx.php?id=10.5720/kjcn.2024.29.1.51

15.Kim L, Choi YH, Huh DA, Moon KW. Associations of minimally processed and ultra-processed food intakes with cardiovascular health in Korean adults: the Korea National Health and Nutrition Examination Survey (KNHANES VI), 2013–2015. Journal of Exposure Science and Environmental Epidemiology [Internet]. 2024 [cited 2024 May 24]; Available from: https://www.nature.com/articles/s41370-024-00646-1

16.Pant A, Gribbin S, Machado P, Hodge A, Wasfy JH, Moran L, et al. Ultra-processed foods and incident cardiovascular disease and hypertension in middle-aged women. European Journal of Nutrition [Internet]. 2024 [cited 2024 May 24];63(3). Available from: https://link.springer.com/content/pdf/10.1007/s00394-023-03297-4.pdf

17.Matias de Pinho MG, Mackenbach J, Lakerveld J, Beulens J, Huybrechts I. Abstract MP11: Ultra-Processed Food Consumption and Cardiovascular Disease in the European Prospective Investigation Into Cancer and Nutrition Study. Circulation [Internet]. 2023 [cited 2024 May 24];147(Suppl_1). Available from: https://www.ahajournals.org/doi/10.1161/circ.147.suppl_1.MP11

18.Honicky M, Cardoso SM, Kunradi Vieira FG, Hinnig PDF, Back IDC, Moreno YMF. Ultra-processed food intake is associated with children and adolescents with congenital heart disease clustered by high cardiovascular risk factors. British Journal of Nutrition [Internet]. 2023 [cited 2024 May 24];129(7). Available from: https://www.cambridge.org/core/journals/british-journal-of-nutrition/article/ultraprocessed-food-intake-is-associated-with-children-and-adolescents-with-congenital-heart-disease-clustered-by-high-cardiovascular-risk-factors/61F13DABDE40E2C06A3814FE9F423FEF

19.Chen J, Wellens J, Kalla R, Fu T, Deng M, Zhang H, et al. Intake of Ultra-processed Foods Is Associated with an Increased Risk of Crohn's Disease: A Cross-sectional and Prospective Analysis of 187 154 Participants in the UK Biobank. Journal of Crohn's and Colitis. 2023;17(4).

20.Sarbagili Shabat C, Zelber-Sagi S, Fliss Isakov N, Hirsch A, Ron Y, Thurm T, et al. P839 Clinical activity in inflammatory bowel diseases is associated with consumption of processed foods. Journal of Crohn's and Colitis. 2023;17(Supplement_1).

21.Lo CH, Ma W, Nguyen LH, Wang Y, Giovannucci E, Strate LL, et al. Sa1926

ASSOCIATION OF ULTRA-PROCESSED FOOD CONSUMPTION WITH RISK OF DIVERTICULITIS. Gastroenterology [Internet]. 2023 [cited 2024 May 25];164(6). Available from: https://www.gastrojournal.org/article/S0016-5085(23)02123-6/pdf

22.Romieu I, Khandpur N, Katsikari A, Biessy C, Torres-Mejía G, Ángeles-Llerenas A, et al. Consumption of industrial processed foods and risk of premenopausal breast cancer among Latin American women: the PRECAMA study. BMJ Nutrition, Prevention and Health [Internet]. 2022 [cited 2024 May 25];5(1). Available from: https://nutrition.bmj.com/content/bmjnph/5/1/1.full.pdf

23.Huybrechts I, Romieu I, Kandpur N, Katsikari K, Torres-Mejia G, Sanchez GI, et al. Ultra-processed food consumption and breast cancer risk. Proceedings of the Nutrition Society [Internet]. 2020 [cited 2024 May 26];79(OCE2). Available from: https://www.cambridge.org/core/services/aop-cambridge-core/content/view/83DD672558CE2A6571D6E0350BFA07BC/S0029665120001305a.pdf/div-class-title-ultra-processed-food-consumption-and-breast-cancer-risk-div.pdf

24.Fraga ACSA, Bastos MP, Theme-Filha MM. Increased consumption of ultra-processed foods during pregnancy is associated with sociodemographic, behavioral, and obstetric factors: A cohort study. Nutrition Research. 2024;121.

25.Carreira NP, de Lima MC, Travieso SG, Sartorelli DS, Crivellenti LC. Maternal factors associated with habitual consumption of ultra-processed foods during pregnancy. Ciencia e Saude Coletiva. 2024;29(1).

26.Sun M, He Q, Li G, Zhao H, Wang Y, Ma Z, et al. Association of ultra-processed food consumption with incident depression and anxiety: a population-based cohort study. Food and Function. 2023;14(16).

27.Contreras-Rodriguez O, Reales-Moreno M, Fernández-Barrès S, Cimpean A, Arnoriaga-Rodríguez M, Puig J, et al. Consumption of ultra-processed foods is associated with depression, mesocorticolimbic volume, and inflammation. Journal of Affective Disorders [Internet]. 2023 [cited 2024 May 26];335. Available from: https://www.sciencedirect.com/science/article/pii/S0165032723006365?via%3Dihub

28.Leal ACG, Lopes LJ, Rezende-Alves K, Bressan J, Pimenta AM, Hermsdorff HHM. Ultra-processed food consumption is positively associated with the incidence of depression in Brazilian adults (CUME project). Journal of Affective Disorders [Internet]. 2023 [cited 2024 May 26];328. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0165032723006365