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THE RELATIONSHIP BETWEEN ULTRA-PROCESSED FOODS (UPFs) AND CARDIOVASCULAR DISEASE AMONG ADULTS: A *SCOPING REVIEW*

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ABSTRACT

Background: The rising global consumption of ultra-processed foods (UPFs) poses a major public health concern due to their association with cardiovascular disease (CVD). UPFs are often high in sodium, saturated fats, added sugars, and artificial additives, contributing to metabolic disturbances and increasing CVD risk. This scoping review aims to synthesize the current evidence on the relationship between UPFs intake and CVD among adults. This scoping review aims to synthesize the current evidence on the relationship between UPFs consumption and CVD risk in adults. Methods: A systematic search was conducted using PubMed and Google Scholar for studies published between 2019 and 2024. Eligible studies included observational research assessing UPFs consumption and its impact on cardiovascular health. A total of 172 articles were initially identified, and after applying inclusion criteria, nine relevant studies were selected for review. Results: High consumption of UPFs is consistently linked with increased risk of hypertension, obesity, dyslipidemia, and elevated triglyceride levels as factors known to contribute to CVD. Some studies also report higher cardiovascular mortality among frequent UPFs consumers, particularly in high-risk populations. In contrast, diets based on minimally processed foods, including fruits, vegetables, and whole grains, show protective effects. Conclusions: UPFs consumption is strongly correlated with elevated cardiovascular risk, underlining the need for urgent public health actions to reduce UPFs intake and promote healthier dietary patterns. Further longitudinal studies are essential to better understand the long-term health consequences of UPFs consumption and inform evidence-based policy and prevention strategies.

Keywords: Ultra Processed Foods, Adult, Cardiovascular disease, *Scoping review*

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INTRODUCTION

The global trend of ultra-processed foods (UPFs) consumption has shown a marked increase over the past decade, particularly in low- and middle-income countries (LMICs). This rise mirrors earlier shifts seen in high-income countries and is largely driven by factors such as urbanization, changing lifestyles, the convenience of ready-to-eat products, and aggressive marketing by food industries. Recent data show that in some populations, UPFs consumption contributes up to 58% of daily energy intake (National, 2024), reflecting its growing role in modern diets.

UPFs are industrial formulations made primarily from refined ingredients and additives, often containing little or no whole food. They are typically high in sodium, saturated fats, trans fats, added sugars, and synthetic additives, while being low in fiber and essential nutrients. These nutritional characteristics can lead to metabolic disturbances, systemic inflammation, and hormonal imbalances that disrupt normal physiological functions. Recent research has highlighted the significant health risks associated with UPFs consumption. A systematic review and meta-analysis found that higher UPFs intake is linked to increased risk of all-cause mortality, cardiovascular disease mortality, and heart-related mortality(Suksatan *et al.*, 2022).

Mounting evidence has linked excessive UPFs consumption to a range of adverse health outcomes. Studies have associated high UPFs intake with increased risks of obesity, metabolic syndrome, type 2 diabetes, and mental health disorders(Elizabeth *et al.*, 2020). A meta-analysis of cohort studies revealed a significant association between higher UPFs consumption and increased risk of cardio-cerebrovascular diseases(Guo *et al.*, 2023). Furthermore, a comprehensive review and meta-analysis demonstrated that UPFs consumption is associated with increased risks of overweight, obesity, metabolic syndrome, and depression in adults, as well as wheezing in adolescents(Lane *et al.*, 2021). These findings underscore the potential negative impact of UPFs on cardiovascular health and overall well-being.

Several mechanisms explain the link between UPFs consumption and cardiovascular risk. High levels of sodium contribute to hypertension, excess saturated fats elevate cholesterol levels, and added sugars lead to obesity and metabolic disorders(Pant *et al.*, 2024). Additionally, artificial additives and preservatives in UPFs may trigger chronic inflammation and oxidative stress, further increasing cardiovascular risk(Saravanan, Khatoon B and Sabarathinam, 2023; Ahmed *et al.*, 2024) Numerous studies have reported that individuals with high UPFs intake are more likely to develop hypertension, dyslipidemia, and obesity as key risk factors for CVD (Mambrini *et al.*, 2023; Quetglas-Llabrés *et al.*, 2023; Ahmed *et al.*, 2024; Oladele *et al.*, 2024). These adverse effects are more pronounced in adults who have established dietary habits and a cumulative exposure to processed food consumption.

Interventions to mitigate the impact of UPFs on cardiovascular health include dietary interventions, public health campaigns, and policy regulations, such as front-of-pack labeling and sugar taxes. Some studies have also emphasized the protective role of whole foods, such as fruits, vegetables, and whole grains, in reducing CVD risk(Fatahi *et al.*, 2018). However, despite growing evidence, there remains a gap in understanding the specific effects of UPFs on different cardiovascular outcomes across diverse populations. The inconsistency in dietary assessment methods and variations in UPFs classification further complicate the interpretation of findings.

Despite the growing literature and evidence, gaps remain in our understanding of the long-term impact of UPFs consumption, especially across diverse demographic and socioeconomic groups. Inconsistencies in dietary assessment methods, UPFs classification, and study designs limit the comparability of findings. Furthermore, most existing studies are concentrated in high-income settings, with relatively fewer investigations from LMICs where dietary transitions are rapidly occurring.

This study aims to systematically review and synthesize the available evidence on the relationship between UPFs consumption and CVD risk in adults. Focusing on the adult population is crucial, as this life stage represents a critical window in which dietary patterns become established and cardiovascular risk accumulates over time. The urgency of this investigation is underscored by the significant increase in UPFs intake in high-income countries and rapidly developing nations such as Indonesia. As urbanization and globalization reshape dietary behaviors, understanding how UPFs affect cardiovascular health across diverse populations becomes increasingly vital.

METHODS

Literature Search Strategy

This scoping review systematically explored the relationship between UPFs consumption and CVD risk among adults. Literature searches were conducted using electronic databases, including PubMed and Google Scholar, focusing on publications from 2019 to 2024. The search terms included “Ultra Processed Food,” “Adult,” and “Cardiovascular Disease.” Articles were selected based on inclusion criteria, which specified observational studies examining the association between UPFs consumption and CVD risk factors following the PRISMA-ScR guidelines(Tricco *et al.*, 2018).

Inclusion and Exclusion Criteria

This scoping review uses strict inclusion criteria to ensure the relevance and quality of the sources analyzed. The studies included in this study are observational studies that have gone through a peer-review process, with cohort or cross-sectional designs, published between 2019 and 2024. The article under consideration is written in English or Indonesian, with full text available. In addition, the selected study specifically examined the relationship between the consumption of UPFs and CVD or its risk factors. Participants in this study were adults aged 18 years or older, including both those with and without pre-existing cardiovascular conditions, as long as the study aimed to assess the incidence, progression, or risk of CVD associated with UPFs consumption.

In contrast, the exclusion criteria include review articles, editorials, comments, and case reports, as well as studies that focus on children, adolescents, or pregnant women as the primary population. Articles that are not available in full-text form, studies do not explicitly assess UPFs consumption or do not include cardiovascular disease-related outcomes, are also excluded from this analysis. As detailed in Fig 1.

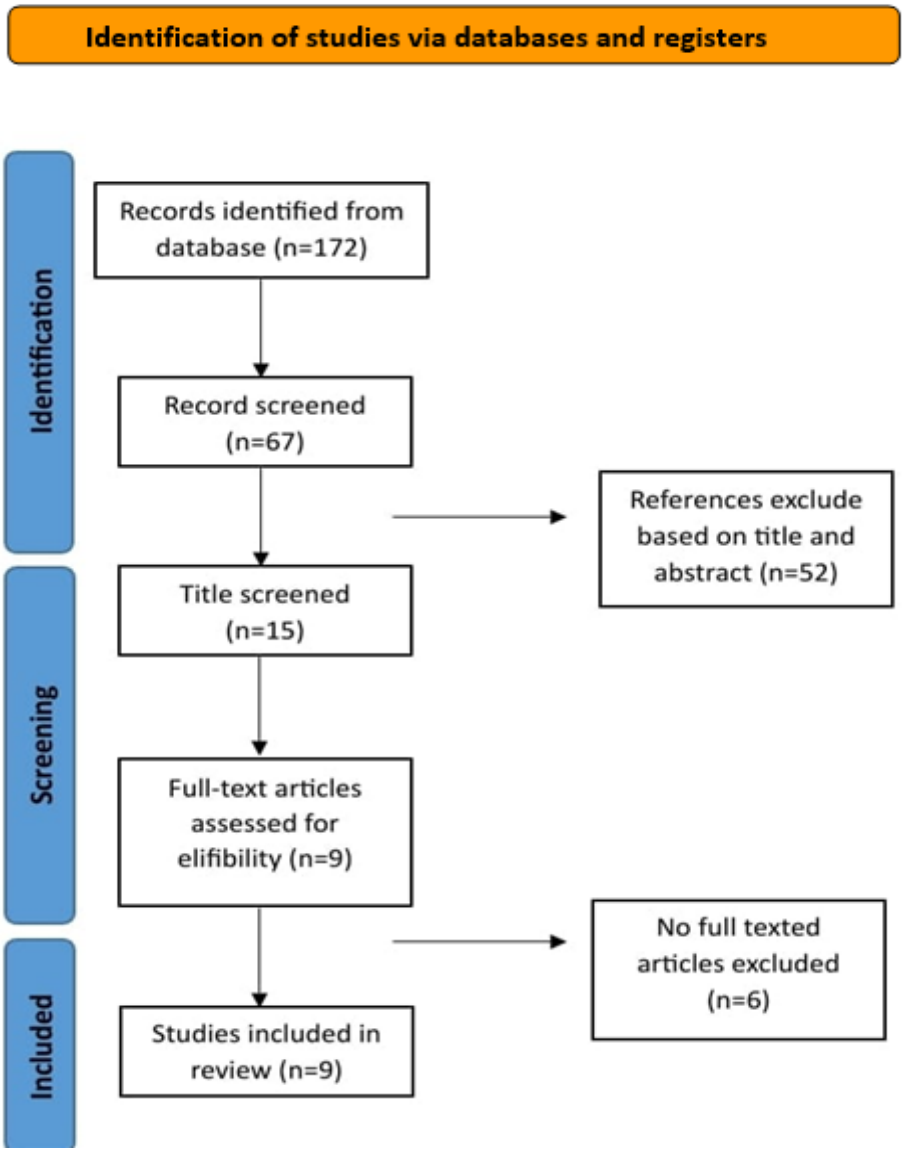

Figure 1. Study selection flow

Determining the focus of the research

After going through the review process, the data will be selected to include: 1) Is there a relationship between ultra-processed consumption and an increased risk of cardiovascular disease? 2) What is the consumption pattern of ultra-processed foods (UPFss) in respondents through a 24-hour dietary assessment, SQ-FFQ, and FFQ questionnaire?

Identifying relevant studies

Data sources are obtained through electronic data bases, namely PubMed and Google Scholar. All academic journals from around the world with full text accessibility in English and Indonesian, relevant to the topic have been searched in depth. issued from

2019 to 2024. The search included observational study research types, in the form of prospective and cross-sectional cohorts.

Study selection

After review by both researchers, the journal decided to consider the relevant data: 1) the study population consists of adults (adults), 2) the association between UPFs and the risk of CVD. As detailed Table 1.

Table 1. Search Keywords in Scoping Review

Search Terms	Filter
("ultra processed food"[All Fields]) AND ("adult"[All Fields]) AND ("cardiovascular disease"[All Fields])	Result by year: 2019 - 2024, Text availability: Free full text, Article type: Observational study.

Charting the data

Studies involving adults (≥18 years) and the elderly population. A study that specifically assessed the intake of ultra-processed foods and their association with cardiovascular disease. Peer-reviewed articles published in the last 6 years for relevance and current findings. Studies reported results of associations on UPFs consumption (e.g., frequency, grams per day) and CVD incidence (e.g., lipid profile, hypertension and heart disease).

Participant criteria

Adults ≥ 18 years old. Participants must not have had prior cardiovascular disease at the start of the study unless the study aims to study the progression of the disease. Studies should include diverse populations based on gender, BMI, and socioeconomic status to understand the broader implications of UPFs consumption across different demographics.

Collating, summarizing, and reporting the results

This research article is summarized into several important points consisting of the country, author, year of publication, research design, participant characteristics, and findings obtained. Then, the information was extracted into an assessment of the relationship between ultra-processed foods and the incidence of cardiovascular disease in the adult and elderly populations

RESULTS AND DISCUSSION

From the search results, the journals that matched the keywords were 172, then included into 9 relevant journals, namely the relationship between ultra-processed foods and the risk of cardiovascular disease. With data collection in the form of 24-hour dietary assessment, SQ-FFQ, and FFQ. All studies used an observational design, in the form of prospective and cross-sectional cohorts.

Country, authors	Study design	Sample	Participant tool	Assessment tool	Results
China,(Li *et al.*, 2022)	Prospective cohorts	105.159	Participants must be at least 18 years old	Questionnaire on sociodemographic and lifestyle characteristics, anthropometry, dietary intake, physical activity.	During an average follow-up period of 5.2 years, ultra-processed food intake was associated with a higher risk of cardiovascular disease overall (1409 cases; hazard ratio to absolute increase of 10 in the percentage of ultra-processed foods in the diet 1.12 (95% confidence interval 1.05 to 1.20); 100,000 person-years)
Europe,(Chen *et al.*, 2022)	Prospective cohorts	60.298	Participants aged 40 years or older	Web-based 24-hour dietary memory questionnaire developed by Oxford WebQ	Higher UPFs intake was associated with a higher risk of CVD and mortality due to all causes (all $P < 0.001$).
America,(Dehghan *et al.*, 2023)	Prospective cohort	138.076	Age 35 - 70 years old	Food frequency questionnaire (FFQ)	A diet with a high intake of UPFs was associated with a higher risk of mortality in a diverse multinational study.
Indonesia, (Safitri *et al.*, 2022)	Cross sectional	63	Age 30 - 59 years old	Semi Quantitative Food Frequency Questionnaire (SQ-FFQ)	The results showed that 52.4 percent of subjects had a TG/HDL ratio of ≥ 3 (high risk), 55.6 percent of subjects had frequent UPFs consumption frequency (≥ 5x per week), and se the majority of subjects had a high UPF calorie and fat intake of 56.3 percent and 51.5 percent, respectively

America, (Juul *et al.*, 2021)	Cohort study	3.003	Age 53.5 years	Food frequency questionnaire (FFQ)	Consumption of ultra-processed foods of each additional serving is associated with a 5-9% increased risk of various types of CVD events and deaths
America, (Zhong *et al.*, 2021)	Cohort study	91.891	Age 55 to 74 years	Food frequency questionnaire (FFQ)	High consumption of ultra-processed foods is associated with an increased risk of cardiovascular death, especially in women
America, (Fang *et al.*, 2024)	Cohort study	74.563	Age 34 years	Semi-quantitative food frequency questionnaire (every four years) to assess the consumption of ultra-processed foods.	The study found that food quality reduced the risk, with better overall dietary quality inversely proportional to mortality in each quartile of ultra-processed food consumption.
Italy, (Bonaccio *et al.*,2021)	Cohort study	22.475	Age 55 years	Semi-quantitative food frequency questionnaire (FFQ)	Individuals with the highest UPFs intake (quartile 4, >14.6% of total food) The sugar content explained the 36.3% association of UPF with IHD/cerebrovascular mortality. Renal function biomarkers accounted for 20.1% of the association of UPFs with all-cause mortality, and 12.0% for CVD mortality.

Spain, (Donat-Vargas *et al.*, 2021)	Cohort study	1821	Age 68 years	Food frequency questionnaire (FFQ)	Triglycerides: The analysis showed a positive association between high UPFs consumption and increased triglyceride concentrations in older adult populations. HDL cholesterol: High consumption of UPFs is associated with lower levels of HDL cholesterol, which can increase cardiovascular risk. LDL cholesterol: There is a significant correlation between high UPFs consumption and increased levels of LDL cholesterol, a major risk factor for cardiovascular disease.	

Association Between UPFs Consumption and CVD Risk

This scoping review confirms a significant association between UPFs consumption and an increased risk of CVD. The reviewed studies consistently indicate that frequent UPFs intake is linked to hypertension, obesity, dyslipidemia, and metabolic disorders, all of which are major risk factors for CVD. UPFs are typically high in sodium, trans fats, added sugars, and artificial additives, which contribute to systemic inflammation, oxidative stress, and endothelial dysfunction. These physiological mechanisms explain why UPF consumption is associated with an elevated incidence of heart disease and stroke. The increasing prevalence of CVD worldwide, particularly among adults, underscores the urgent need to address the impact of dietary patterns on cardiovascular health.

The findings highlight that individuals consuming diets rich in UPFs tend to have poorer cardiovascular health outcomes compared to those following whole-food-based diets. Studies have shown that higher UPFs consumption correlates with increased cholesterol, triglycerides, and blood pressure(Leffa *et al.*, 2020; Smiljanec *et al.*, 2020; Donat-Vargas *et al.*, 2021). In contrast, diets emphasizing whole, minimally processed foods such as fruits, vegetables, legumes, and whole grains demonstrate protective effects against CVD(Islam *et al.*, 2021). These findings support existing dietary recommendations that advocate for reducing UPFs intake and increasing the consumption of nutrient-dense, natural foods(Knez, Ranić and Gurinović, 2023; Beal *et al.*, 2024). Public health initiatives should reinforce the benefits of whole-food diets to mitigate CVD risk at the population level.

Research Gaps

Despite growing evidence linking UPFs consumption to cardiovascular risks, several research gaps remain. Variations in dietary assessment tools and UPFs classification criteria across studies pose challenges in standardizing findings. Some studies rely on self-reported dietary data, which may introduce recall bias and inaccuracies in estimating consumption, including UPFs(Dicken *et al.*, 2024; Schönenberger *et al.*, 2024). Additionally, most research focuses on high-income countries, while data from low- and middle-income populations remain limited(Vedovato *et al.*, 2015; Srinivasan and Yadav, 2023). Future studies should employ standardized dietary assessment methods and expand research to diverse populations to enhance the generalizability of findings.

Public Health Implication

Another important consideration is the role of policy interventions in reducing UPFs consumption and improving cardiovascular health(Popkin *et al.*, 2024). Several countries have implemented front-of-pack labeling, taxation on sugary and highly processed foods, and public health campaigns to encourage healthier eating habits(Gorski and Roberto, 2015; Acton *et al.*, 2019; de Faria *et al.*, 2023) However, the effectiveness of these policies varies depending on cultural, economic, and regulatory factors(Hoek *et al.*, 2021; Lawrence, 2023). More research is needed to evaluate the long-term impact of such interventions and identify the most effective strategies for reducing UPFs consumption. Strengthening public awareness and accessibility to healthier food alternatives should be a key focus of future public health policies.

In conclusion, this review provides strong evidence supporting the detrimental effects of UPFs consumption on cardiovascular health. Given the rising burden of CVD, reducing UPFs intake should be prioritized in dietary guidelines and health promotion programs. Public health strategies should emphasize education, policy regulations, and community-based interventions to encourage healthier food choices. Future research should address existing knowledge gaps by refining dietary assessment methods and exploring the effectiveness of interventions in various populations. A shift toward whole-food-based diets is essential to reducing the global burden of cardiovascular disease and improving long-term health outcomes.

Differences Across Countries and Population Subgroups

A critical observation in this review is the geographic and demographic variability in study findings. Most research is concentrated in high-income countries, where food environments are highly industrialized, and dietary patterns skew toward convenience foods. However, the inclusion of studies from LMICs, such as Indonesia, reveals that similar health risks are emerging as these countries undergo dietary transitions driven by urbanization and globalization(Colozza, Wang, and Avendano 2023).

Furthermore, age-related differences also emerge. For example, in studies involving older adults (Donat-Vargas et al., 2021), high UPFs consumption was associated with worsened lipid profiles, including increased LDL and decreased HDL cholesterol. Conversely, some studies among younger adults suggest a faster onset of metabolic disturbances. These findings suggest that the cumulative effects of UPFs intake may vary

based on age, socioeconomic status, and existing comorbidities highlighting the need for age-specific dietary guidelines and interventions.

Towards a Global Dietary Shift

In light of the mounting evidence, this review underscores the urgent need for a global shift toward minimally processed, nutrient-dense diets. Reducing UPFs consumption is not merely an individual responsibility but a collective imperative that demands structural changes in food systems and public policy. As CVD continues to rise worldwide, the transformation of global dietary patterns offers a crucial opportunity to reverse this trend and promote long-term health and sustainability.

LIMITATION

This study has several limitations that should be acknowledged. First, the reliance on observational studies means that causal relationships between UPFs consumption and CVD cannot be definitively established. Many studies used self-reported dietary assessments, which may introduce recall bias and inaccuracies in estimating actual UPFs intake. Additionally, variations in UPFs classification across studies make direct comparisons challenging, as different research methodologies may categorize foods differently. Most of the included studies focused on high-income countries, limiting the generalizability of findings to low- and middle-income populations where dietary patterns and food availability differ. Future research should incorporate standardized dietary assessment tools and longitudinal studies to strengthen the evidence base and address these limitations.

CONCLUSION

In conclusion, this review highlights a strong association between UPFs consumption and an increased risk of CVD. The high sodium, sugar, and trans fat content in UPFs contributes to key cardiovascular risk factors, including hypertension, obesity, and dyslipidemia. To mitigate these risks, it is recommended that individuals reduce UPFs consumption and adopt a diet rich in whole, minimally processed foods such as fruits, vegetables, and whole grains. From a policy perspective, governments should implement stricter food labeling regulations, taxation on unhealthy processed foods, and educational campaigns promoting healthier dietary choices. Additionally, public health initiatives should focus on improving food literacy and increasing access to affordable, nutritious alternatives, particularly in vulnerable populations. Strengthening multi-sectoral collaboration between policymakers, health professionals, and the food industry is essential to reducing the global burden of CVD through improved dietary habits.

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