

Review

Ultra-Processed Food Consumption and Obesity and Adiposity Among Young Adults: A Narrative Review of Recent Evidence

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Abstract

Ultra-processed foods (UPFs) are foods formulated through extensive industrial processing, with little or no natural food constituents, and include ingredients such as artificial colors, flavors, and other food additives to enhance shelf life and palatability. They are typically energy-dense and poor in essential nutrients, including products such as sugar-sweetened beverages, packaged snacks, processed meats, instant noodles and confectioneries. UPF intake has been associated with a wide range of metabolic and inflammatory diseases, especially obesity and adiposity. The transition to independent living and increased dietary autonomy among young adults, particularly university students, are associated with higher reliance on UPF. This narrative review aims to examine the global evidence on the association between UPF consumption and obesity and adiposity outcomes among young adults. Most reviewed studies demonstrated a consistent positive association between UPF consumption and increased obesity and adiposity risks among young adults. UPF consumption within this population is substantial, ranging between 25% and 50% of total energy intake (TEI). The association between UPF consumption and increased risk of obesity and adiposity can be explained through multiple biological and behavioral mechanisms, including high energy density and palatability, disruption of satiety signaling, gut microbiota alterations, and hormonal dysregulation. To reduce the long-term burden of obesity among young adults, public efforts should be directed to important health interventions, such as university awareness nutritional programs, front-of-pack labeling, and policy-level restrictions on UPF marketing.

Keywords: ultra-processed food; NOVA system; NOVA classification; obesity; adiposity; body composition; young adults; university students



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1. Introduction

The globalization of food systems is a term that has been widely used recently to describe the substantial shift away from traditional foods towards fast, ready-to-eat meals, and energy-dense foods, especially ultra-processed foods (UPFs) [1]. UPFs are industrial formulations that undergo extensive processing and include ingredients such as artificial colors, flavors, and other food additives to enhance shelf life and palatability [2]. Because UPFs are more convenient for modern lifestyles, hyperpalatable, well-marketed, and often have lower costs when compared to fresh, minimally processed foods, they contribute significantly to total energy intake in both developing and developed countries [3,4].

UPF intake has been associated with a wide range of metabolic and inflammatory diseases, such as type 2 diabetes, cardiovascular diseases, types of cancer, frailty, irritable bowel disease, depression, and various cardiometabolic risk factors [5–11].

Adiposity refers to the physical state of having body fat (adipose tissue). It is a descriptive term for the quantity or distribution of fat. Obesity, however, is a diagnosed medical disease of having an excess of body fat to the point where it negatively impacts your health and well-being [12]. Obesity is a global public health epidemic and a main driver for multiple metabolic and inflammatory diseases. Dieting is one of the significant and modifiable risk factors for obesity, and modern diets have cast light on UPF consumption as a key contributor to obesity. However, obesity prevalence continues to rise rapidly, and it is predicted that more than 50% of adults globally will be overweight or obese by 2030 [13]. Prospective cohort studies reported a strong association between higher UPF consumption and increased risks of obesity, overweight and abdominal obesity [14,15]. Moreover, a randomized controlled trial that investigated whether UPF affected total energy intake among twenty adults at the NIH Clinical Center revealed that total energy intake was higher when participants received a UPF diet and body weight increased significantly with energy intake during the UPF diet period [16].

Among young adults, including university students, the transition to independent living and increased autonomy over food choices has resulted in increased consumption of UPF and unhealthy dietary patterns, contributing to excessive weight gain, adiposity and metabolic diseases [17].

This narrative review aims to summarize evidence on the association between UPF consumption and obesity or adiposity among young adults, while providing a comprehensive overview of UPF and the proposed biological and behavioral mechanisms by which UPF may increase the risk of obesity and adiposity.

2. Search Strategy

This narrative review aims to review the global evidence on the association between UPF consumption and obesity or adiposity among young adults. Eligible studies included original research published from 2016 onward. A comprehensive search was conducted across major electronic databases, including PubMed, SpringerLink, Scopus, and ScienceDirect. The search strategy used a combination of the following Medical Subject Headings (MeSH) and keywords: (“ultraprocessed food*” OR “ultra-processed food*” OR “NOVA system” OR “NOVA classification” OR “minimally processed food”) AND (“Obesity” OR “BMI” OR “Adiposity” OR “Body composition” OR “Fat analysis” OR “Fat mass” OR “Visceral fat”) AND (“Young Adults” OR “University Students” OR “College students”). Only original studies were included, while review articles, systematic reviews, meta-analyses, conference abstracts, and non-original publications were excluded. Following the screening process, 12 original studies were included in the final review. The full search strategy is summarized in Table 1.

Table 1. Summary of the search strategy.

Items	Specification
Date of search	April–May, 2026
Databases and other sources searched	PubMed; SpringerLink; Scopus; and ScienceDirect

Table 1. *Cont.*

Items	Specification
Search terms used	Ultraprocessed food; ultra-processed food; NOVA system; NOVA classification; minimally processed food; obesity; BMI; adiposity; body composition; waist circumference; fat analysis; body fat percentage; visceral fat; central adiposity; young adults; university students; college students
Time Frame	2016–2026
Inclusion and exclusion criteria	Only original studies were included, while review articles, systematic reviews, meta-analyses, conference abstracts, and non-original publications were excluded.

3. Ultra-Processed Food Overview

3.1. UPF and NOVA System

In 2009, Foods were classified into four categories in a detailed system called the NOVA system, developed by Monteiro et al. in Brazil [18]. Foods were categorized according to the type, degree, and intended purpose of industrial processing into four food groups [18]. These groups (Figure 1) have been defined as follows:

- Group 1: Unprocessed/minimally processed foods; these are natural edible parts of plants or animals with no processing or minimally processed. Processing is done only to make the food edible, such as cutting vegetables, drying fruits, or grinding meat.
- Group 2: Processed culinary ingredients; these are obtained from natural foods to be used in food preparation, such as sugars, salts, fats and oils.
- Group 3: Processed foods; this group includes canned or bottled natural foods like vegetables, fruits, fish, and pulses. They are manufactured by mixing group 2 ingredients into group 1 food to increase the durability of these foods or enhance sensory qualities.
- Group 4: Ultra-processed food (UPF); these are formulated with extensive levels of industrial processing using little or no natural food constituents, and include ingredients such as artificial colors, flavors, and other food additives to enhance shelf life and palatability [2]. They are typically energy-dense and poor in essential nutrients (e.g., sugar-sweetened beverages, packaged snacks, processed meats, instant noodles and confectioneries) [2,19].

UPFs are more convenient nowadays due to their affordability, hyperpalatability and cost [2]. However, evidence has linked high UPF intake to adverse health outcomes, particularly obesity and metabolic disorders [14–16]. Prospective studies from large cohorts such as the European Prospective Investigation into Cancer and Nutrition (EPIC) and UK Biobank have consistently demonstrated that individuals with higher UPF consumption have significantly higher risks of being overweight, obese, and having central adiposity [14,15]. Experimental research confirms that UPFs contribute to excessive energy intake and weight gain [16].

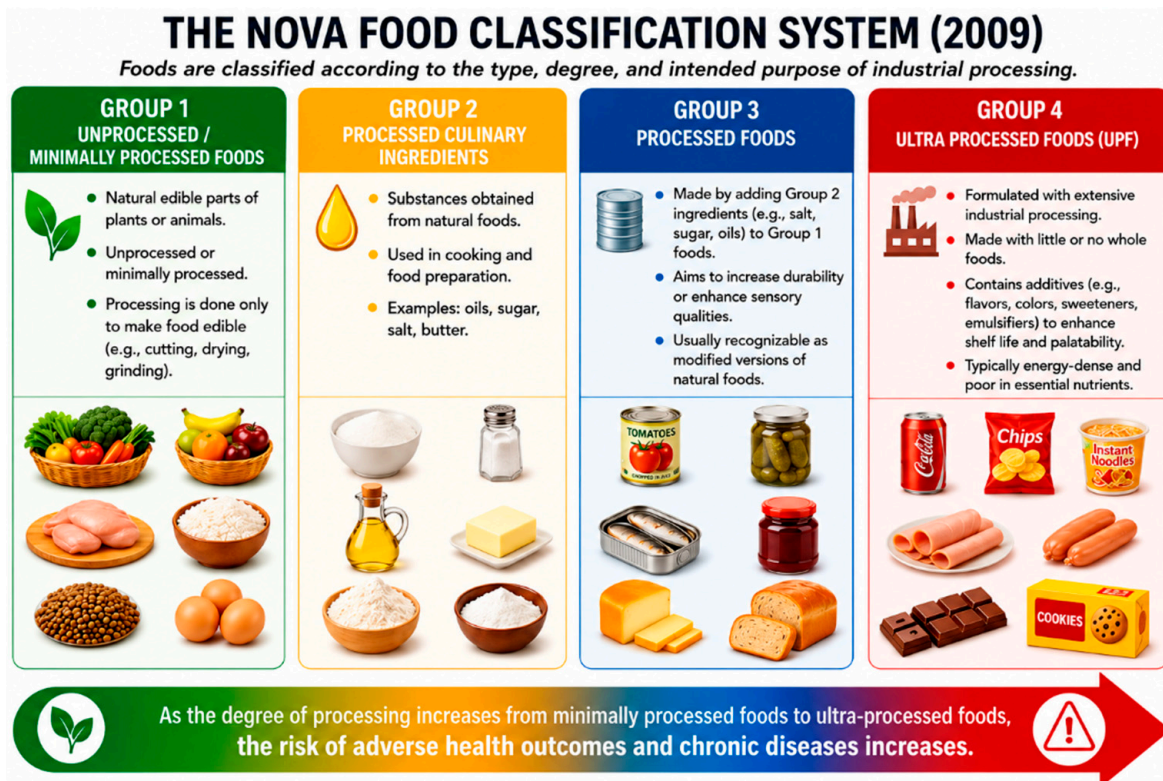


Figure 1. The NOVA food classification system. The figure summarizes the four groups of the NOVA system. Foods are categorized according to the type, degree, and intended purpose of industrial processing into Group 1: Unprocessed/Minimally processed foods (e.g., fruits, vegetables, and eggs); Group 2: processed culinary ingredients (e.g., oils, sugar, and salt); Group 3: processed foods (e.g., canned goods and cheese); and Group 4: ultra-processed foods (UPFs), such as soft drinks, packaged snacks, and processed meats, which are industrially formulated, energy-dense, and poor in essential nutrients. The risk of adverse health outcomes and chronic diseases increases progressively with the degree of food processing (from left to right) [2,18].

3.2. UPF and Dietary Patterns

Research consistently shows that individuals with high UPF consumption tend to consume greater amounts of added sugars, fats, and sodium, with lower intake of fibers and fresh foods [20]. They are less likely to follow healthy dietary patterns, a Mediterranean diet (MD) or traditional diets that emphasize higher intake of whole grains, fruits, vegetables, and legumes [21,22]. Evidence from young adult populations supports this inverse relationship between UPF consumption and adherence to an MD. In Greece, UPF consumption among university students was negatively associated with the MD Score (Spearman $r_s = -0.214$, $p < 0.001$) [23]. Similarly, in Saudi Arabia, higher adherence to the MD was associated with lower consumption of UPF, fast-food, ready-to-eat meals, and UPF beverages [24]. Although these findings are consistent in direction, both studies are cross-sectional and regionally specific, which limits their generalizability and their ability to assess temporal associations.

UPF shifts populations mostly towards westernized dietary patterns, characterized by high fast-food intake, sugary beverages, processed meats, and refined grains [25,26].

Dietary patterns that contain high UPF consumption contribute to excessive energy intake and replace nutrient-dense foods. Such patterns lead to severe micronutrient deficiencies and metabolic dysregulation [27]. Furthermore, the habitual consumption of UPFs reinforces preferences for hyperpalatable, energy-dense foods, making it more challenging for individuals to adhere to healthier dietary guidelines [16]. These behavioral changes represent one of the most important mechanisms through which UPF consumption perpet-

uates poor diet quality at the population level and warrant greater attention in both public health messaging and dietary counseling.

3.3. UPF Consumption Through Different Age Groups

Given the rapid urbanization and the expansion of modern food systems, a marked shift toward UPF consumption has been observed globally. UPF consumption is commonly expressed as a percentage of total energy intake (%TEI). However, intake levels vary substantially between different countries and age groups [28]. A systematic review of 106 manuscripts from 21 countries reported that the United States had the highest levels of intake, followed by the United Kingdom, both exceeding 50% of TEI. While Italy showed the lowest intake, at approximately 10% of TEI, likely reflecting the adherence to MD patterns [28]. Additionally, this review indicates that UPF consumption is highest during childhood and adolescence and tends to decrease with age, despite children's diets being largely influenced by parental choices. For instance, in the United Kingdom, average consumption among primary and secondary children reaches approximately 65% of TEI [29]. Similarly, in Canada and the United States, pediatric populations consume above 55% of TEI from UPF. Children consume UPF derived from white bread, cookies, processed meat products, milk-based drinks, crisps, chips, soda, bottled juices and ready-to-eat meals [30,31], while UPFs contribute to 66.4% of TEI among adolescents in the United States [32]. These numbers raise concerns about how childhood and adolescent dietary patterns are tracked into adulthood, suggesting that early high UPF consumption may have extended adverse effects on dietary behaviors and metabolic health. This is often underemphasized in UPF research, which tends to focus on cross-sectional snapshots rather than longitudinal dietary trajectories.

During adulthood, UPF consumption starts to decline; however, UPF consumption among young adults remains significantly high, often exceeding 50% of TEI in the US and the UK. This may be attributed to the transitional nature of the 18–35-year age group, during which individuals begin to develop dietary independence after entering college or university. This often leads to high reliance on UPF and lifestyle changes [28]. We believe that this transitional vulnerability makes young adults a uniquely high-risk group, while it has received little attention relative to pediatric and older adult populations in the UPF literature. Targeted dietary interventions during this stage may therefore prevent the long-term effects of UPF consumption toward obesity and metabolic disease.

3.4. UPF and Health

UPF intake has been associated with a wide range of metabolic and inflammatory diseases such as type 2 diabetes, cardiovascular diseases, types of cancer, frailty, irritable bowel disease, depression, and various cardiometabolic risk factors [5–11].

Findings from a large cross-sectional study suggest that low-grade systemic inflammation may play an important role in these associations [33] through increased levels of complement component 3 (C3), C-reactive protein (CRP), interleukin 6 (IL-6), tumor necrosis factor-alpha (TNF- α), leptin, resistin, white blood cell counts (WBCs) and specific WBC subtypes such as neutrophils and basophils, as well as a higher neutrophil-to-lymphocyte ratio [33]. Because obesity serves as a central player contributing to many of these conditions, mediation analyses were conducted and showed that adiposity partially mediates the relationship between UPF intake and inflammatory biomarkers. The proportion of the total effect mediated ranged from 12.7% to 70.1% in models including body mass index (BMI), and from 13.5% to 64.5% in models including waist-to-height ratio (WHtR) [33].

3.5. Obesity vs. Adiposity

Obesity is recognized by the World Health Organization (WHO) as a chronic, complex disease, defined based on BMI ≥ 30 kg/m² [34]. While BMI is widely used as a key indicator of obesity in epidemiological research due to its simplicity and feasibility, its limitations are well recognized, especially the inability to differentiate between fat mass and lean mass, or between subcutaneous and visceral fat distribution [35]. Consequently, relying on BMI to assess obesity might misclassify people in both directions: individuals with a normal BMI but excess body fat, known as metabolically obese normal weight (MONW), while muscular individuals with high lean mass may be incorrectly classified as obese [34].

Adiposity refers to the level and distribution of body fat accumulation in the body and has been recently recognized as an indicator of obesity and its related health consequences [36]. There are two types of adiposities based on fat distribution: central (abdominal) adiposity and peripheral adiposity [12]. Central adiposity is characterized by the accumulation of fat tissue around the abdomen, particularly visceral fat around internal organs, and is strongly associated with adverse metabolic outcomes [12,37]. Adiposity is assessed through more direct and precise measurement techniques such as bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DEXA), CT scans, and skinfold thickness measurements. These can precisely measure several body composition parameters, including fat mass (FM), body fat percentage (BF%), and visceral fat level (VFL) [38–42]. In large epidemiological studies, central adiposity is assessed indirectly using waist circumference (WC) because of its simplicity and feasibility, as shown in Table 2 [43–45].

Table 2. Summary of commonly used adiposity indicators in epidemiology [43–45].

Indicator	Measure	Method	Strength	Limitation
WC (cm)	Central obesity	Using a measuring tape	Good predictor of cardiometabolic risk	Cannot distinguish between visceral and subcutaneous fat
WHtR	Central adiposity relative to body size	WC/HC	Better predictor than BMI in some populations	Cut-offs vary across populations
Body Fat (%)	Total BF proportion	BIA, DEXA, skinfolds thickness	More accurate than BMI for adiposity	Method-dependent variability (BIA is less accurate than DEXA)
Visceral Fat (mass/area)	Fat around internal organs	DEXA, CT, MRI, advanced BIA	Strong predictor of metabolic risk	Expensive (CT/MRI); limited availability
FFM (Kg)	Lean body mass (muscle, organs, water)	BIA, DEXA	Important for body composition balance	Indirect measure of adiposity
SMM (Kg)	Muscle component of lean mass	BIA, DEXA	Relevant for metabolic health	Measurement variability depending on method
VFA (cm ²)	Quantified abdominal VF	CT, MRI, advanced BIA	Highly specific for central obesity risk	Not widely available in large studies

Abbreviations: BMI: body mass index; WC: waist circumference; HC: hip circumference; WHR: waist-to-hip ratio; BIA: bioelectrical impedance analysis; DEXA: dual-energy X-ray absorptiometry; CT: computerized tomography; MRI: magnetic resonance imaging; FFM: fat-free mass; SMM: skeletal muscle mass; VFA: visceral fat area.

4. UPF Consumption in Relation to Obesity and Adiposity Indicators

Among all health conditions, there is particularly strong and consistent evidence linking higher UPF consumption to increases in obesity, as measured by BMI and adiposity indices [38–42].

Among young adults, including university students, the transition to independent living and increased autonomy over food choices, as well as the high reliance on convenience and processed foods, especially within campus settings and student housing, resulted in increased consumption of UPF and unhealthy dietary patterns, contributing to excessive weight gain, adiposity, and metabolic diseases [17]. This section summarizes the current evidence on the association between UPF consumption and obesity as well as adiposity among young adults, organized by outcome measures, across diverse populations and geographic settings. The available evidence is mainly observational studies, with studies largely consisting of cross-sectional analyses (Table 3).

4.1. UPF Consumption and BMI/Body Weight

Multiple cross-sectional and prospective studies link higher UPF intake with elevated BMI and body weight among young adults. A multi-center observational study conducted across different higher educational institutions in Chile ($n = 2039$ students) explored the association between UPF consumption and obesity risk [46]. This study suggests a positive dose–response relationship between UPF sugary drinks and odds of obesity in university students, one serving/day (OR = 1.32, 95% CI: 1.00–1.74), two servings/day (OR = 1.30, 95% CI: 1.04–1.50), and three servings/day (OR = 1.39, 95% CI: 1.05–1.80) [46]. Notably, sweet and salty snacks were not independently associated with obesity risk in this study, suggesting that the obesogenic effect of UPF may not be uniform across all subcategories, and that liquid calories from sugary beverages may carry a particularly strong effect [46]. However, the cross-sectional design of this study hinders conclusions about whether sugary beverage consumption preceded weight gain or vice versa.

In line with these findings, a sample of 250 public university students in Malaysia answered a 24 h dietary recall administered via an online questionnaire, along with self-reported weight and height, for BMI calculation [47]. UPF contributed 31% of TEI, and UPF consumption was positively associated with BMI among young adults (Spearman's $r_s = 0.16$, $n = 250$, $p = 0.014$) [47]. Although the association is statistically significant, the effect size is considered modest. This may be attributed to methodological limitations, including the reliance on self-reported weight and height, and a single 24-Hr recall, which may have introduced measurement error and led to underestimation of both BMI and UPF intake, potentially attenuating the true association.

Similarly, a cross-sectional study conducted across two distinct urban cities (Yogyakarta, Indonesia and Shanghai, China) enrolled 320 participants from universities and community health centers [48]. Individuals with the greatest UPF consumption had a 2.6-fold greater risk of being obese compared to those in the lowest tertile (OR = 2.63; 95% CI: 1.55–4.47, $p < 0.01$). Subgroup analysis identified sugar-sweetened beverages and packaged snacks as the primary UPF subcategories contributing to obesity risk [48]. These findings strengthen the generalizability of the association as they confirm the significance of results among two distinct urban settings across Asia.

Longitudinal evidence further supports these associations. A prospective cohort study conducted among 8451 middle-aged Spanish university graduates (SUN) with normal weight were followed up on for a median of 8.9 years [49]. Weight was self-reported at baseline and after 9 years. After adjustment for potential confounders, participants in the highest quartile of UPF consumption versus participants in the lowest quartile of consumption were at a higher risk of being overweight or obese (Adjusted HR = 1.26;

95% CI: 1.10–1.45; p -trend = 0.00). Dietary intake was assessed using a validated semi-quantitative FFQ, and weight and height were self-reported [49]. However, the use of self-reported weight and height at both time points may have introduced measurement bias, given the tendency of individuals to underreport body weight and overreport height.

In Miami, USA, 140 college students (18–24 years old) were asked to self-report three 24 h dietary recalls, along with weight and height at baseline and after 12 weeks [50] to assess the association between UPF snacks and beverages with weight and changes in BMI. Results revealed that participants with obesity tend to consume significantly greater UPF snacks compared to their normal-weight counterparts [50]. Among the 87 participants who completed weight reporting in 12 weeks, increased intake of UPF snacks was associated with an increase in BMI gain over the follow-up period ($\beta = 0.280$, $p < 0.05$). Suggesting a short-term impact of UPF snack consumption on weight trajectory in young adults [50]. Together, these longitudinal studies confirm a temporal and consistent positive association between UPF consumption and weight gain among young adults [49,50].

Sugar-sweetened beverages and packaged snacks showed the most consistent association with obesity risk, as demonstrated by both the Chilean and the Indonesia–China comparative studies [46,48], suggesting that the obesogenic effect of UPF is not similar across UPF subcategories and that the strongest effect might be from liquid calories and highly palatable foods.

4.2. UPF Consumption and Waist Circumference

WC is widely used in epidemiological studies to assess abdominal central obesity. It is independently associated with all-cause mortality [51]. Evidence also suggests that WC is associated with UPF intake [23,24].

For instance, in 2023 at the University of the Peloponnese, Greece, a cross-sectional study among 346 students investigated the association between UPF and obesity. UPF contributed $40.7 \pm 13.6\%$ (mean $\pm$ standard deviation) of TEI and was significantly associated with an increase in WC in men only. However, UPF consumption was not significantly related to BMI in either the total sample or when stratified by sex [23].

Similarly, researchers from King Abdulaziz University, Jeddah, Saudi Arabia conducted a cross-sectional analysis among 190 Saudi young adult participants to examine the association between UPF consumption and both BMI and WC [24]. Results showed that higher UPF consumption was significantly associated with a 30.2% higher BMI and a 23% increase in mean WC. In addition, UPF intake was associated with increased odds of being overweight or obese ($\text{BMI} > 25 \text{ kg/m}^2$; OR = 2.966, 95% CI: 1.86–4.21) and of having abdominal obesity (OR = 2.610, 95% CI: 1.46–3.97) [24].

These findings suggest that UPF consumption is associated with an increase in WC and central obesity among young adults, with sex differences that might reflect fat distribution patterns, as males tend to accumulate more fat in the abdominal region. These results highlight a critical limitation of relying only on BMI in UPF research. Because central adiposity, assessed through WC, may be a more sensitive and independent relevant outcome in this population, future studies should adopt multiple-outcome approaches to adiposity assessment.

4.3. UPF Consumption and Adiposity Indices

While BMI is widely used as a key indicator of obesity in epidemiological research due to its simplicity and feasibility, its limitations are well recognized, especially the inability to differentiate between fat mass and lean mass, or between subcutaneous and visceral fat distribution [35]. A growing body of evidence has examined the association between UPF consumption and direct adiposity indices, including BF%, FM, VFL, and FFM. These indices can precisely measure several body composition parameters and help identify adiposity and its metabolic consequences. A cross-sectional study in Pune, India among 110 university students of both genders examined the association between UPF intake and adiposity as measured by BMI, BF%, and visceral fat levels (VFLs) [52].

Higher UPF intake was not associated with BMI, but it showed a trend toward increased BF% ($p = 0.053$) and was significantly associated with VFL accumulation in the whole population, without sex stratification ($p < 0.05$), [52]. Consistent with previous findings, Budiargo et al. (2025) conducted a cross-sectional study at the Faculty of Public Health Universitas Indonesia (FPH UI) [53].

They explored the association between UPF consumption measured by both frequency and energy intake, with obesity measured as BF% among 147 students. Nearly half of the students reported a high frequency of UPF intake (51%) and high UPF energy intake (46.3%). Results showed that UPF consumption frequency and UPF energy intake were both significantly associated with elevated BF% (OR = 3.075, $p = 0.034$; OR = 3.837, $p = 0.010$, respectively). This suggests that both the frequency and the quantity of UPF daily intake may independently contribute to excess adiposity [53]. Complementary findings were reported by a prospective cohort study conducted within the Kiel Obesity Prevention Study (KOPS, $n = 10,750$), Germany, which assessed the association between UPF consumption and its effect during young adulthood on weight, BMI, FM, and FFM [54]. Among 182 young adults, UPF intake accounted for nearly 50% of TEI and was significantly higher among overweight participants than among normal-weight participants ($p < 0.05$). Sex-stratified analysis revealed that male participants in the highest tertile of UPF consumption had higher body weight, BMI, and FM than those in the lowest tertile of UPF consumption [54]. These sex-specific findings suggest that male young adults may be particularly vulnerable to the adverse effects of UPF consumption on body composition, though the underlying mechanisms warrant further investigation. Taken together, evidence from cross-sectional and prospective studies consistently links higher UPF consumption to elevated adiposity indices beyond BMI, particularly BF% and VFL. We suggest that future UPF research should move beyond BMI as the primary outcome and use multi-parameter body composition assessments, such as dual-energy X-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA), to more accurately characterize the adipogenic impact of UPF consumption in young adults.

4.4. Inconsistent Findings and Methodological Considerations

Not all studies, however, reported consistent findings [55,56]. A cross-sectional study in Ghana found that UPF consumption was not associated with WC or BMI among 352 university students [55]. However, male students with higher UPF frequency (1–6 times/day) had significantly higher blood pressure [55]. Similarly, a cross-sectional study conducted in Portugal failed to find a significant association between UPF intake and any body composition indices among a sample of 163 university students [56]. These inconsistencies may be attributable to limitations in methodological or analytical approaches. In the Ghana study, researchers did not adjust for confounding variables, such as physical activity, sleep, stress, and socioeconomic status, through multivariable regression or stratified analyses. Thus, the true relationship between UPF intake and obesity outcomes may have been masked by these factors [55].

In the Portuguese study, participants were recruited through convenience sampling and drawn from one faculty, which introduced a selection bias by attracting those who are more health-conscious. Additionally, dietary intake was self-reported through two 24 h dietary recalls; this may lead to underestimation of UPF intake due to social desirability bias, especially among female participants, who comprised a larger proportion of the studied sample. Moreover, the study sample was relatively small ($n = 163$), which further reduced its statistical power to detect even small significant effect sizes [56]. Nevertheless, findings highlight a consistent positive association between UPF consumption and obesity and adiposity indicators. This was supported by prospective studies and is reflected across multiple anthropometric and body composition outcomes.

Results from the Ghana and Portugal studies are not contradictory evidence; these are methodologically instructive cases that highlight the conditions necessary for reliably detecting these associations.

To ensure that results from future studies are more consistent, several methodological improvements are warranted. First, increasing sample size and making it more representative by recruiting participants through random, multi-site sampling rather than convenience sampling to enhance statistical power and generalizability. Second, to reduce bias from measurement errors and social desirability, it is recommended to use validated dietary assessment tools, such as validated FFQs or multiple-day dietary records. It is important in future studies to adopt standardized UPF classification criteria like the NOVA system to ensure that UPF exposure is defined and measured consistently across studies, enabling meaningful cross-national comparison. Finally, it is recommended to adjust for key confounders, such as physical activity, socioeconomic status, sleep, and total energy intake, using multivariable regression or stratified analyses. Together, all these improvements would help clarify whether the observed inconsistencies reflect true population differences or are largely artefacts of study design.

Table 3. Summary of studies on the association between UPF intake and obesity-related outcomes worldwide among young adults.

Author, Country, Year	Study Design	Participants	Exposure Assessment	Outcome Assessment	Results
Durán-Agüero et al. [46] (2021, Chile)	Multi-center, observational, descriptive study.	1947 participants. - University students. - Age: 18–39 yrs old.	- Validated eating habit survey. - Administered by nutritionists and researchers.	- Wt. - Ht. - BMI - Taken by nutritionists/researchers.	≥1 serving/day of sugary beverages was associated with → ↑ odds of obesity; ≥1 serving/day: (OR: 1.32 (95% CI: 1.00–1.7)); =2 servings/day: (OR: 1.30 (95% CI: 1.04, 1.50)); =3 servings/day (OR: 1.39 (95% CI: 1.05, 1.80)). Intake of both sweet and salty snacks were not significantly related to differential odds of obesity.
Ganesrau et al. [47] (2023, Malaysia)	Cross-sectional study	250 participants. - Public university students. - Age: 18–30 yrs old.	- Online self-administered 24 h dietary record. - Food was classified based on the NOVA approach.	- Online, self-reported, Wt. and Ht. - BMI	- UPF among participants = 31% of TEI. - The average BMI = 23.10 (7.38) kg/m². - Significant positive correlation between UPF and BMI ($r_s = 0.16$, $n = 250$, $p = 0.014$).
Detopoulou et al. [23] (2023, Greece)	Cross-sectional study	346 participants. Students at the University of the Peloponnese. - Age: 19.6 ± 3.1 yrs old.	- Semi-quantitative food frequency questionnaire (FFQ). - Meal frequency. Meals, patterns and timings.	- Wt. - Ht. - WC - HC - BMI	- UPF intake: $40.7 \pm 13.6\%$ of TEI. ↑ UPF consumption → ↑ WC in men only. ↑ UPF consumption → ↓ adherence to MedDietScore (Spearman $r_s = -0.214$, $p < 0.001$). ↑ UPF consumption → ↓ adherence to an “early eating” pattern (Spearman $r_s = -0.120$, $p = 0.029$). ↑ UPF consumption → ↑ with a “late eating” meal pattern (Spearman $r_s = 0.190$, $p = 0.001$).
Sekyi et al. [55] (2024, Ghana)	Cross-sectional study	352 university students. - Age: 22.3 ± 2.4 yrs old.	- Validated FFQ. - Food items were categorized according to the NOVA system.	- Wt. - Ht. - BMI - WC - BP	- NOVA food category consumption was not significantly associated with WC and BMI status. - UPF intake in males only (1–6 times/day) → ↑ BP.
Mendonça, Pimenta et al. [49] (2016, Spain)	Prospective Cohort Study (nine-yr follow-up)	8451 participants. - Graduates, Spanish university students. - Initially healthy and normal weight.	- Self-administered 136-item validated semiquantitative FFQ. - Conducted at baseline only. - Food items were categorized according to the NOVA system.	- Ht. - Wt. - Self-administered. - BMI	- After 9 years of follow-up: a total of 1939 cases of overweight and obesity incidence. - Participants with the highest UPF consumption vs. lowest are: ↑ risk of developing overweight/obesity. (adjusted HR: 1.26; 95% CI: 1.10, 1.45; p-trend = 0.001).

Table 3. Cont.

Author, Country, Year	Study Design	Participants	Exposure Assessment	Outcome Assessment	Results
Ghosh and Muley [52] (2025, India)	Cross-sectional study	110 participants. - University students. - Age: 18–24 yrs old. - Health.	- Validated FFQ. - Applied the NOVA system to classify food items. - Administered by researchers.	- Ht. - Wt. - BMI - BF% - VFL	↑ higher UPF consumption, associated with: ○ ↑ BF% ($p = 0.053$) ○ ↑ VFL ($p < 0.05$) ↑ higher UPF consumption was not associated with bowel movement, gastrointestinal symptoms, or menstrual cycle irregularities ($p > 0.05$).
Monteiro et al. [56] (2026, Portugal)	Cross-sectional study	163 participants. - Portuguese University. - Age: ≥ 18 yrs old.	- Two nonconsecutive 24 Hr recalls. - By trained interviewers. - The NOVA system was used to classify food items.	- Wt. - Ht. - WC - HC - BF% - FFM - BMI - WHtR	- UPF contributed 24.8% of TEI. - No associations were found between UPF and BC.
Putri and Zhang [48] (2025, Indonesia and China)	Cross-sectional study	320 participants. - Young adults. - Age: 18–30 yrs old. - Universities and health centers in both cities.	- Validated semi-quantitative FFQ. - Food items were categorized according to the NOVA system.	- Wt. - Ht. - BMI - By a trained researcher.	The highest tertile of UPF intake compared to the lowest UPF intake: ↑ risk of obesity $\rightarrow$ 2.6-fold (OR = 2.63; 95% CI: 1.55–4.47, $p < 0.01$). - UPF consumption mainly from: sugar-sweetened beverages and packaged snacks.
Chowdhury et al. [50] (2026, USA)	1. Cross-sectional analysis 2. Longitudinal analysis	- Cross-sectional: 140 participants. - Longitudinal: 87 participants. - Healthy. - USA college students. - Age: 18–24 yrs old.	- Three 24 Hr recalls. - Self-administered	- At baseline: ○ Wt. ○ Ht. ○ BMI - After 12 wks.: ○ Wt. ○ BMI	Cross-sectional: Obese vs. non-obese: Obese individuals consumed significantly more $\rightarrow$ Overall, UPF snacks, soft drinks, sports drinks, chips and dips, and ice cream ($p < 0.05$). Longitudinal: Overall intake of UPF snacks was significantly associated with an increase in BMI ($\beta = 0.280$, $p < 0.05$).

Table 3. Cont.

Author, Country, Year	Study Design	Participants	Exposure Assessment	Outcome Assessment	Results
Fedde et al. [54] (2024, Germany)	Cohort Study	- Kiel Obesity Prevention Study (KOPS). 313 participants. - Age: 23–31 yrs old. - Participated in KOPS before.	- Two 24 Hr recalls. - Categorized by the NOVA system. - Administered by researchers and dietitians.	- By a trained researcher: - Wt. - Ht. - BMI - FM - FFM	↑UPF intake in overweight young adults. - In males → the highest tertile of ↑UPF intake vs. the lowest intake of UPF intake: ○ ↑ Wt. ○ ↑ BMI ○ ↑ FMI - Adults in the 3rd tertile of UPF consumption vs. the 1st tertile had: ○ ↓ intake of fiber and salt. ○ ↑ energy-dense foods.
Alomari et al. [24] (Saudi Arabia, 2025)	Cross-sectional study	190 participants. - Healthy. - University students. - Age: 18–25 yrs old.	- Two 24 Hr. - Self-administered. - Foods classified according to the NOVA system.	- Self-reported: ○ Wt. ○ Ht. ○ WC - BMI	↑ UPF consumption linked to: ○ 30.2% higher BMI. ○ 23% increase in mean WC. ○ ↑ odds of having BMI > 25 kg/m². (OR = 2.966; 95% CI: 1.86, 4.21). ○ ↑ odds of abdominal obesity. (OR = 2.610; 95% CI: 1.46, 3.97).
(Budiargo et al. [53] (Indonesia, 2025)	Cross-sectional study	147 participants. - Healthy. - University students. - Age: 19–23 yrs old.	- Semi-quantitative FFQ. - Food items are categorized according to the NOVA system. - Administered by a trained nutrition student.	- BF% - Administered by a trained nutrition student.	~51% of participants → high frequency of UPF consumption. 46.3% of participants → high UPF energy intake. - Obesity is significantly associated with UPF consumption frequency ($p = 0.034$; OR = 3.075). - Obesity is significantly associated with UPF energy intake ($p = 0.010$; OR = 3.837).

Abbreviations: UPF: ultra-processed food; FFQ: food frequency questionnaire; Wt.: weight; Ht.: height; Yrs: years; WC: waist circumference; HC: hip circumference; BP: blood pressure; VFL: visceral fat levels; FFM: fat-free mass; 24 Hr: 24 h dietary recall; WHtR: waist-to-hip ratio; TEI: total energy intake; BF%: body fat percentage; OR: odds ratio; CI: confidence interval; HR: hazard ratio; →: linked/ associated with; ↑: increase; ↓: decrease.

5. How UPF Consumption Affects Obesity and Adiposity

The association between UPF consumption and increased risk of obesity and adiposity among young adults can be explained through multiple biological and behavioral mechanisms, summarized in Figure 2.

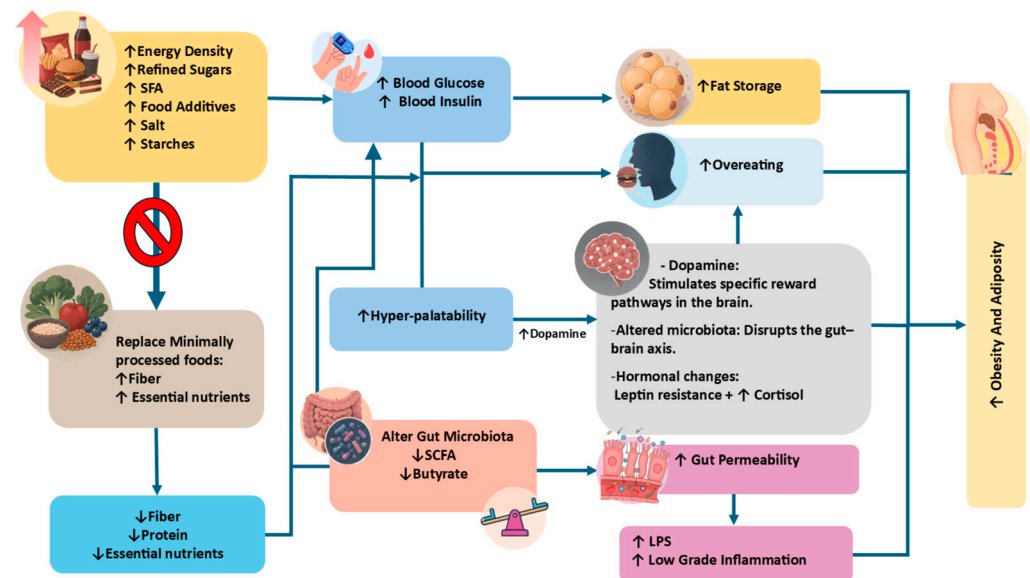


Figure 2. Proposed mechanism of how UPF may affect obesity and adiposity. This figure illustrates multiple biological and behavioral mechanisms of how UPF consumption may increase the risk of obesity and adiposity. UPF is characterized by elevated levels of refined sugars, SFA, food additives, salt, and starches, while replacing MPF and displacing dietary fiber and essential nutrients. These nutritional properties converge on five major biological pathways: (1) The high glycemic load of UPF causes hyperglycemia and hyperinsulinemia, subsequently promoting hunger and fat storage. (2) Dopamine is stimulated by these hyperpalatable foods, which leads to stimulating specific reward pathways in the brain, which may override physiological signals of fullness and encourage compulsive eating patterns. (3) UPF negatively alters gut microbiota composition and diversity and reduces some beneficial metabolites production, such as SCFA and butyrate. These changes may (a) impair metabolic homeostasis by decreasing insulin sensitivity and satiety signaling; (b) weaken gut barrier function and promote dysbiosis; (c) disrupt the gut–brain axis, influencing appetite regulation and energy balance through neuroendocrine signaling pathways; and (d) increase intestinal permeability, leading to elevated circulating LPS and chronic low-grade inflammation. All these play a major role in obesity pathogenesis. (4) UPF intake may contribute to leptin resistance, where the brain resists the effect of this hormone, promoting weight gain and adiposity. (5) High UPF consumption may dysregulate cortisol and stress-related metabolic pathways, potentially contributing to disrupted energy balance and adiposity.

5.1. High Energy Density and Hyperpalatability

UPFs are energy-dense foods and highly palatable due to high added sugars, food coloring, flavorings, refined starches, saturated fats, and salts. Thus, they are typically consumed at a faster eating rate due to their soft texture, which reduces oro-sensory exposure and impairs satiety, potentially promoting higher energy intake [57].

Moreover, dopamine is stimulated by these hyperpalatable foods, which leads to stimulating specific reward pathways in the brain, which may override physiological signals of fullness and encourage loss-of-control eating behaviors, compulsive overeating, and recurrent binge eating episodes resulting in some eating disorders (EDs), such as binge eating disorder and bulimia nervosa [58–60].

This is reflected in clinical data; a retrospective study conducted at a specialized ED center in the UK assessed the UPF contribution to TEI among individuals with EDs [60].

Individuals with binge eating disorder consumed approximately 69% of their TEI from UPF, while those with bulimia nervosa reported an even higher proportion of 72% of TEI [60]. These percentages are markedly high and suggest that UPF is associated with loss-of-control eating behaviors, leading to increased obesity and adiposity.

5.2. Impact on Gut Microbiota and Metabolic Endotoxemia

High UPF intake has been associated with decreased abundance of *Lachnospira* and *Roseburia*, which are two microbiota genera that produce some beneficial metabolites such as short-chain fatty acids (SCFAs) [61,62]. Consequently, reduced SCFA production may impair metabolic homeostasis by decreasing insulin sensitivity and satiety signaling, which will contribute to weight gain and adiposity [63,64]. SCFAs may influence central appetite regulation and reward-related feeding behavior via gut-derived hormonal signals (such as GLP-1 and PYY) and neural communication pathways, thereby potentially contributing to alterations in food cravings and dietary intake patterns [64,65]. Among SCFAs, butyrate is particularly important due to its key role in colonic health. It serves as the primary energy source for colonocytes and is essential for maintaining intestinal epithelial integrity; reduced production may compromise gut barrier function and promote dysbiosis by favoring less beneficial bacterial populations [66,67].

Moreover, UPF consumption has been associated with gut microbial alterations characterized by increased abundance of taxa such as *Granulicatella*, *Blautia*, *Carnobacteriaceae*, *Bacteroidaceae*, *Peptostreptococcaceae*, *Bacteroidia*, and *Bacteroidetes* [68]. These microbial alterations can disrupt the gut–brain axis, potentially influencing appetite regulation and energy balance through neuroendocrine signaling pathways [65,68].

Beneficial bacterial species, such as *Faecalibacterium prausnitzii* and *Akkermansia muciniphila*, possess anti-inflammatory properties. Emulsifiers commonly used in the production of UPF have been found to reduce the prevalence of these beneficial microorganisms, leading to increased intestinal permeability, elevated circulating lipopolysaccharides (LPSs) and chronic low-grade inflammation, all of which play a pivotal role in obesity pathogenesis [62,69].

5.3. Replacement of Nutrient-Dense Foods

UPFs may replace whole natural foods, such as vegetables, fruits, pulses, legumes, and whole grains. This dietary shift will lead to deficiencies in essential micronutrients and bioactive compounds that play roles in cell metabolism and may protect against weight gain and metabolic disturbances [70]. Additionally, the displacement of fiber-rich whole foods by UPFs is associated with reduced gut distention, increased gastric emptying, impaired gut health, and altered energy regulation; this causes reduced satiety signals and increased total caloric intake [16,66]. In addition, simple refined sugars can induce hyperglycemia and hyperinsulinemia, subsequently promoting hunger and fat storage [71].

5.4. Hormonal Dysregulation

Leptin is a hormone that normally regulates appetite, energy expenditure and body weight. Excessive UPF intake may contribute to leptin resistance, where the brain resists the effect of this hormone, promoting weight gain and adiposity. In addition, chronic inflammation resulting from obesity and poor-quality diets can further exacerbate leptin resistance, perpetuating a cycle of overeating and increased adiposity [72]. The latest evidence suggests that chronic low-grade inflammation associated with high UPF consumption may also influence cortisol regulation and stress-related metabolic pathways, potentially contributing to disrupted energy balance and adiposity [73].

6. Conclusions

This narrative review summarizes global evidence from 12 observational studies, suggesting a positive association between UPF consumption and increased obesity and adiposity risks among young adults, especially university students.

UPF consumption within this population ranges between 25% and 50% of TEI, highlighting the high dietary contribution of these products within this population, although most reviewed studies are of a cross-sectional nature that limits causal inference and the heterogeneity of findings across diverse geographic settings, populations, and outcome measures. The association is most observed for BMI, body weight, waist circumference, and body fat percentage. These associations are biologically plausible and can be explained through multiple biological and behavioral mechanisms, including high energy density, hyperpalatability, disruption of satiety signaling, gut microbiota alterations, hormonal dysregulation, and displacement of nutrient-dense foods.

Given the overall evidence suggesting a positive association between UPF consumption and obesity-related outcomes, universities and colleges may play an important role in promoting healthier dietary behaviors among young adults. Potential strategies include implementing nutrition awareness campaigns tailored to this age group and improving the availability and accessibility of healthy, minimally processed food options on campus, while increasing the availability and accessibility of healthy and minimally processed snack alternatives. At a policy level, restrictions on UPF marketing should be emphasized by taxing and front-of-pack labeling. To strengthen the causal inference and temporality of the findings, future research should prioritize well-designed prospective longitudinal studies that apply validated UPF dietary tools and evaluate obesity and adiposity using multiple body composition indicators. Moreover, research interest should be expanded to other underrepresented geographical regions, including eastern and western Asia.

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Abbreviations

SFA: saturated fatty acid; MPF: minimally processed food; SCFA: short-chain fatty acid; LPS: lipopolysaccharide.

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