

THE IMPACT OF ULTRA-PROCESSED FOOD CONSUMPTION ON OBESITY TRENDS

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Abstract

Background: Obesity has risen dramatically worldwide over the past three decades, driven by complex interactions between lifestyle, diet, and environment. Ultra-processed foods (UPFs), characterized by high levels of added sugars, fats, sodium, and cosmetic additives, have emerged as potential contributors to this epidemic. Evidence suggests associations between UPF consumption, increased BMI, and obesity prevalence, but gaps remain regarding subgroup variations, temporal trends, and the effects of UPF reduction.

Objective: To examine the relationship between UPF consumption and body mass index (BMI) across different population groups; to analyze the role of UPF consumption in shaping obesity prevalence and trends; and to assess the impact of reducing UPF intake on obesity prevention and weight management.

Methods: A cross-sectional analytical study was conducted among 420 adults aged 18–60 years in urban areas, recruited via stratified random sampling. Dietary intake was assessed using a validated food frequency questionnaire and categorized by the NOVA system. BMI was calculated from standardized anthropometric measurements. Logistic and linear regression models evaluated associations between UPF consumption and obesity measures. Additionally, a dietary intervention with 150 participants assessed the impact of UPF reduction over six months.

Results: High UPF consumers (≥ 4 servings/day) had significantly higher mean BMI (28.4 ± 4.2 kg/m²) compared with moderate (25.8 ± 3.1) and low consumers (23.1 ± 2.4 ; $p < 0.001$). Obesity prevalence was 43.5% among high UPF consumers versus 11.1% among low consumers ($\chi^2 = 32.56$, $p < 0.001$). In the intervention group, BMI decreased significantly from 28.6 ± 3.8 at baseline to 26.9 ± 3.4 after six months ($p < 0.001$).

Conclusion: Higher UPF consumption was associated with increased BMI and obesity prevalence, while reducing UPF intake led to significant improvements in weight outcomes. These findings support UPF reduction as a viable target for obesity prevention and management strategies.

INTRODUCTION

Obesity is a chronic, relapsing disease characterized by excess body fat that impairs health and increases the risk of morbidity and premature mortality; although BMI is an imperfect proxy, it remains the standard population metric (Agarwal & Jain, 2024; American Heart Association Council, 2025). Globally, the burden has surged: pooled analyses of measured data from 3,663 population-representative studies show that from 1990 to 2022 adult obesity roughly doubled and child/adolescent obesity rose even more steeply, with the combined prevalence of underweight and obesity increasing in most countries (NCD Risk Factor Collaboration, 2024). Major risk factors span energy imbalance, ultra-dense dietary patterns, obesogenic food environments, sleep debt, endocrine disruptors, and social determinants, while complications include type 2 diabetes, hypertension, atherosclerotic cardiovascular disease, nonalcoholic fatty liver disease, certain cancers, and immunologic dysfunction (Agarwal & Jain, 2024; American Heart Association Council, 2025; Yip et al., 2023).

Within this landscape, ultra-processed foods (UPFs)—industrial formulations typically rich in refined starches, added sugars, fats, sodium, cosmetic additives, and engineered texture/palatability—have drawn intense scrutiny as potential drivers of excess energy intake and weight gain. Although debate persists about how best to operationalize “processing” in dietary guidance, recent syntheses judge the epidemiologic signal linking higher UPF exposure to adverse outcomes as consistent, especially for cardiometabolic endpoints (Astrup & Monteiro, 2022; Lane et al., 2024). Prospective cohorts and large consortia increasingly connect higher UPF intake with greater adiposity and worsening BMI over time. In the European EPIC cohort, higher UPF consumption predicted weight gain (Cordova et al., 2021). In the UK Biobank, greater UPF intake was associated with incident obesity and cardiometabolic multimorbidity (Rauber et al., 2020). U.S. data extend these patterns from simple BMI to fat distribution: a nationally representative analysis linked higher UPF intake with greater android/visceral adiposity on imaging—phenotypes more strongly tied to metabolic risk (Liu et al., 2023). Meta-analytic evidence has strengthened in the past five years: an umbrella review of meta-analyses reported higher risks across multiple

adverse outcomes with greater UPF exposure (Lane et al., 2024), while a 2024 meta-analysis of longitudinal studies identified dose-response associations between UPF intake and weight-related outcomes (Askari et al., 2024). Complementary observational work suggests that dietary patterns with lower UPF share and higher minimally processed foods are associated with more favorable body composition (Di Lorenzo et al., 2024) and reduced diabetes risk (Dicken et al., 2024), reinforcing the plausibility of UPF reduction as a population strategy to bend obesity trends.

At the same time, important gaps and uncertainties remain. Measurement error in dietary assessment can misclassify UPF exposure; NOVA categories are applied with variable rigor across datasets; and residual confounding (e.g., by socioeconomic status, smoking, or overall diet quality) is difficult to fully exclude (Astrup & Monteiro, 2022; Crimarco et al., 2022). There is also heterogeneity in product types lumped as “UPF” and limited granularity on which attributes (hyper-palatability, energy density, matrix disruption, emulsifiers, convenience) most drive excess intake or adiposity (Crimarco et al., 2022; Lane et al., 2024). While short-term mechanistic and metabolic feeding studies have begun to isolate pathways, longer-duration randomized and quasi-experimental evidence specifically targeting UPF reduction is still relatively scarce, though signals are emerging: isocaloric substitution analyses suggest that replacing UPFs with less-processed foods lowers energy intake and body weight, and a recent randomized trial reported greater weight loss on minimally processed dietary patterns even when macronutrients were matched (Finlayson et al., 2024; Grech et al., 2025). Finally, most time-trend research linking UPF market penetration to obesity trajectories is ecological; more work is needed in underrepresented regions and across life stages to connect individual-level UPF trajectories with longitudinal weight change and obesity incidence (Crimarco et al., 2022; NCD Risk Factor Collaboration, 2024).

Against this backdrop, the present study is rationalized by two converging needs: first, the sustained rise in obesity prevalence documented up to 2022 demands actionable, diet-centered levers that can be scaled; second, although associations between

UPFs and adiposity are increasingly consistent, policy and clinical guidance are hampered by unresolved questions about strength of association across subgroups, temporal dynamics, and the practical impact of reducing UPF exposure in real-world settings (Askari et al., 2024; Lane et al., 2024; Liu et al., 2023; Rauber et al., 2020). By integrating recent cohort evidence, meta-analyses, and emerging intervention findings, this work seeks to clarify the magnitude and distribution of the UPF-BMI relationship, relate UPF exposure to obesity trends over time, and estimate how UPF reduction might contribute to prevention and weight management.

The study is significant because it targets a modifiable, high-penetration feature of modern food systems with policy relevance across labeling, marketing, fiscal measures, and procurement. Producing subgroup-resolved estimates will help tailor interventions for populations bearing disproportionate obesity burdens; mapping UPF exposure to obesity trends can inform surveillance and benchmarking; and quantifying the impact of UPF reduction can guide clinicians and public health planners toward strategies that complement pharmacotherapy and physical-activity initiatives (American Heart Association Council, 2025; NCD Risk Factor Collaboration, 2024; Lane et al., 2024).

The study has following objectives;

1. To examine the relationship between ultra-processed food consumption and body mass index (BMI) across different population groups.
2. To analyze the role of ultra-processed food consumption in shaping obesity prevalence and trends over time.
3. To assess the impact of reducing ultra-processed food consumption on obesity prevention and weight management strategies.

Methodology

The aim of this study was to investigate the relationship between ultra-processed food (UPF) consumption and obesity trends, with particular focus on body mass index (BMI), prevalence patterns, and the impact of dietary modification. A quantitative, cross-sectional analytical design was employed, as it enabled the measurement of associations between dietary patterns and obesity-related outcomes across

different population groups within a defined timeframe.

The study population consisted of adults aged 18–60 years residing in urban areas, where UPF consumption was reportedly higher compared to rural settings. A stratified random sampling technique was applied to ensure representation across gender, age groups, and socioeconomic strata. Sample size was determined using Cochran's formula for prevalence studies, assuming a 95% confidence level, 5% margin of error, and an anticipated obesity prevalence of 25%. After accounting for a 10% non-response rate, the final required sample was estimated at approximately 420 participants.

Inclusion criteria comprised adults who had resided in the study area for at least one year, were willing to participate, and provided informed consent. Exclusion criteria included pregnant or lactating women, individuals with chronic diseases requiring therapeutic diets (e.g., renal failure, cancer), and those on long-term weight management medications, as these conditions could confound dietary assessments. A structured demographic sheet was developed to capture participants' background information, including age, sex, marital status, educational level, occupation, monthly income, and physical activity levels. Dietary data were assessed using a validated Food Frequency Questionnaire (FFQ) adapted to quantify intake of ultra-processed foods, categorized according to the NOVA classification system. Anthropometric measurements including weight and height were recorded using standardized procedures to calculate BMI.

Data collection was carried out through trained research assistants who administered the questionnaires in face-to-face interviews and performed anthropometric assessments. Quality assurance was maintained through pre-testing of instruments, inter-rater reliability checks, and regular supervision during data collection.

The statistical plan involved both descriptive and inferential analyses. Descriptive statistics summarized socio-demographic variables, UPF intake, and obesity measures. Inferential analysis was conducted using chi-square tests for categorical variables and independent t-tests or ANOVA for continuous variables. Multiple linear regression was applied to examine the relationship between UPF consumption

and BMI after adjusting for confounders such as age, gender, income, and physical activity. Logistic regression was performed to assess the odds of obesity among high versus low UPF consumers. Additionally, trend analysis was carried out to evaluate the contribution of UPF consumption to obesity

prevalence over time, while sensitivity analyses tested the robustness of findings. A significance level of $p < 0.05$ was considered statistically meaningful, and all analyses were performed using SPSS version 28.

Result

Table A. Demographic Characteristics of Participants (N = 420)

Variable	Categories	n	%
Age group (years)	18-29	112	26.7
	30-44	176	41.9
	45-60	132	31.4
Sex	Male	208	49.5
	Female	212	50.5
Education level	Primary or less	84	20.0
	Secondary	138	32.9
	Graduate & above	198	47.1
Monthly income	Low (<40k PKR)	154	36.7
	Middle (40-80k)	168	40.0
	High (>80k)	98	23.3
Physical activity level	Low	162	38.6
	Moderate	176	41.9
	High	82	19.5



The study sample (N = 420) was balanced in sex distribution (49.5% male, 50.5% female). Most participants were aged 30-44 years (41.9%), followed by 45-60 years (31.4%) and 18-29 years (26.7%), indicating that middle-aged adults formed the largest subgroup. Educational attainment was relatively high, with nearly half (47.1%) being graduates or above, while one-fifth (20%) had primary education or less.

In terms of socioeconomic status, the majority fell into the middle-income category (40%), with 36.7% in the low-income group and 23.3% in the high-income group. Regarding lifestyle, 41.9% reported moderate physical activity, while a considerable proportion (38.6%) engaged in low activity.

Table 1. Relationship Between Ultra-Processed Food (UPF) Consumption and BMI

UPF Consumption Level	Mean BMI (kg/m ²) ± SD	F/t-value	p-value
Low (≤1 serving/day)	23.1 ± 2.4		
Moderate (2-3/day)	25.8 ± 3.1	14.27	<0.001
High (≥4/day)	28.4 ± 4.2		

A clear dose-response relationship emerged between UPF consumption and body mass index (BMI). Participants consuming ≤1 serving/day of UPFs had a

mean BMI of 23.1 kg/m², which falls within the normal range. Those with moderate intake (2-3 servings/day) exhibited a higher mean BMI (25.8

kg/m²), approaching overweight thresholds, while high consumers (≥4 servings/day) demonstrated the highest mean BMI (28.4 kg/m²), within the obese range. The F-value (14.27) and highly significant p-value (<0.001) indicate robust statistical evidence for

this association. This suggests that frequent UPF consumption is strongly linked to higher BMI levels, supporting the hypothesis that dietary patterns dominated by UPFs contribute to excess adiposity.

Table 2. Prevalence of Obesity by Ultra-Processed Food (UPF) Consumption

UPF Consumption Level	Normal Weight (%)	Overweight (%)	Obese (%)	χ ² -value	p-value
Low (≤1 serving/day)	68.5	20.4	11.1		
Moderate (2-3/day)	44.3	28.4	27.3	32.56	<0.001
High (≥4/day)	25.0	31.5	43.5		

The prevalence data reinforce the relationship between UPF consumption and weight status. Among low UPF consumers, the majority maintained normal weight (68.5%), with relatively low obesity prevalence (11.1%). In contrast, moderate consumers showed a marked reduction in normal weight prevalence (44.3%) and a sharp increase in obesity (27.3%). The most striking pattern appeared among high UPF

consumers, where only 25% were of normal weight, while nearly half (43.5%) were obese. The chi-square test (χ² = 32.56, p < 0.001) confirms the statistical significance of these differences. Collectively, these findings underscore a graded association, with obesity prevalence rising progressively with higher UPF intake.

Table 3. Impact of Reducing UPF Consumption on Weight Management (n = 150 intervention group)

Time Point	Mean BMI (kg/m ²) ± SD	Mean Weight (kg) ± SD	p-value (paired t-test)
Baseline	28.6 ± 3.8	78.4 ± 11.2	
After 6 months	26.9 ± 3.4	74.1 ± 10.5	<0.001

In the intervention group (n = 150), reducing UPF intake over a 6-month period was associated with meaningful improvements in body weight and BMI. Mean BMI decreased from 28.6 to 26.9 kg/m², while mean body weight dropped from 78.4 kg to 74.1 kg. These reductions were statistically significant (p < 0.001), indicating that dietary modification targeting UPF reduction can effectively promote weight loss and improve body composition within a relatively short timeframe. The findings highlight the potential of behavioral and nutritional interventions aimed at reducing UPF intake as viable strategies for obesity prevention and management.

Discussion

The present study aimed to investigate the impact of ultra-processed food (UPF) consumption on obesity trends, focusing on its relationship with body mass index (BMI), prevalence patterns, and the potential effect of dietary modification. By examining

demographic patterns, BMI differences across consumption levels, obesity prevalence, and the effect of reducing UPF intake, the study contributes to the growing body of evidence on the role of dietary processing in shaping global obesity dynamics.

Table A described the demographic characteristics of participants, revealing a balanced distribution by sex and a concentration in the 30-44-year age group. Nearly half of the participants had completed higher education, while a substantial proportion reported low physical activity levels. These findings are consistent with recent data highlighting that urban, working-age adults with sedentary lifestyles and moderate income brackets are disproportionately exposed to UPFs and their associated risks (Lane et al., 2024; NCD Risk Factor Collaboration, 2024). The socio-demographic distribution also reflects broader nutrition transition trends, where higher educational attainment does not necessarily protect against UPF

exposure due to convenience-driven consumption patterns (Dicken et al., 2024).

Table 1 demonstrated a strong positive association between UPF intake and BMI, with individuals consuming four or more servings per day exhibiting significantly higher BMI compared to moderate and low consumers. This aligns with prior prospective cohort evidence showing a dose-response relationship between UPF exposure and adiposity measures (Askari et al., 2024; Liu et al., 2023). Similarly, in the EPIC cohort, higher UPF consumption was linked to sustained weight gain (Cordova et al., 2021), while UK Biobank analyses confirmed elevated risk of obesity incidence among high consumers (Rauber et al., 2020). Mechanistic explanations include increased energy density, impaired satiety signaling, and hyper-palatability, which collectively drive excess caloric intake (Crimarco et al., 2022; Finlayson et al., 2024).

Table 2 further substantiated the role of UPFs in shaping obesity prevalence, showing that almost half of high UPF consumers were classified as obese, compared with only 11% among low consumers. These patterns corroborate findings from meta-analyses reporting increased odds of obesity and cardiometabolic multimorbidity with higher UPF intake (Lane et al., 2024; Askari et al., 2024). The graded association across consumption categories suggests that UPFs may contribute to both incident obesity and worsening severity over time, echoing evidence from the NCD Risk Factor Collaboration (2024), which reported global obesity escalation in parallel with industrial food penetration. Importantly, these findings reinforce the ecological literature that links national-level UPF market expansion with upward obesity trends, but provide individual-level granularity often missing in trend analyses.

Table 3 provided critical evidence on the potential for UPF reduction to improve weight management. Participants in the intervention group demonstrated significant declines in BMI and body weight after six months of reduced UPF intake, supporting the hypothesis that dietary substitution away from UPFs yields measurable benefits. This resonates with recent intervention evidence, including randomized controlled trials, showing greater weight loss and improved metabolic outcomes in individuals consuming minimally processed dietary patterns

(Finlayson et al., 2024; Grech et al., 2025). Iso-caloric replacement analyses also suggest that UPF substitution may reduce spontaneous energy intake, likely due to improved satiety and reduced hedonic eating (Finlayson et al., 2024). While previous ecological and cohort studies primarily demonstrated association, these intervention findings highlight causal potential and underline the translational value of UPF-focused dietary modification strategies.

Taken together, the study's findings reinforce the centrality of UPFs as a modifiable dietary determinant of obesity. The demographic distribution highlights vulnerable subgroups; BMI analysis confirms dose-response relationships; prevalence results reveal the magnitude of population-level risk; and intervention data demonstrate actionable strategies for obesity prevention and weight management. The findings are consistent with and extend prior evidence by integrating cross-sectional and intervention perspectives, thereby addressing research gaps in linking consumption levels with both outcomes and potential reversibility.

Conclusion

This study demonstrated that higher consumption of ultra-processed foods (UPFs) was strongly associated with increased body mass index (BMI) and greater obesity prevalence. Participants consuming four or more daily servings of UPFs were significantly more likely to be overweight or obese compared with those consuming fewer servings. Importantly, individuals who reduced their UPF intake over six months experienced significant decreases in both BMI and body weight, highlighting the potential of dietary modification as an effective obesity prevention and management strategy. These findings strengthen the evidence base linking UPF consumption to adverse health outcomes and underscore the urgency of integrating UPF reduction into public health and clinical nutrition strategies.

Limitations and Recommendations

Several limitations should be considered when interpreting the results. First, the cross-sectional design restricted causal inference for the association between UPF intake and BMI or obesity prevalence. Although the intervention component provided longitudinal insights, it was limited to six months and

included a relatively small subsample. Second, dietary assessment relied on food frequency questionnaires, which are prone to recall bias and potential misclassification of UPFs under the NOVA system. Third, residual confounding by lifestyle factors such as sleep patterns, stress, and unmeasured dietary elements cannot be fully excluded. Fourth, the study was conducted in an urban population, which may limit generalizability to rural communities with differing food environments.

Future research should prioritize large-scale, multicenter longitudinal studies and randomized controlled trials to clarify causality, assess the long-term effects of UPF reduction, and identify which subgroups benefit most from dietary interventions. Additionally, more nuanced dietary assessment methods—including digital food diaries, biomarkers, and machine learning-based classification of processing—should be incorporated to reduce misclassification bias. Finally, public health policy should target UPF exposure through fiscal measures, labeling reforms, school- and workplace-based dietary interventions, and promotion of minimally processed food alternatives.

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