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HEALTH AND REHABILITATION

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IMPACT OF ULTRAPROCESSED FOOD CONSUMPTION ON VISCERAL FAT ACCUMULATION. CROSS SECTIONAL ANALYSIS USING BIO IMPEDANCE ANALYSIS.

Original Research

Dr. Umair Ahmad Siddiqui[1]*, Farmanullah Khan, Ali Hassan, Hamzah Khurram, Dr. Muhammad Kamran
[1]Fellow Endocrinology, Services Hospital, Lahore
[2]Post Graduate Resident MD (Endocrinology), Services Hospital Lahore
[3]Fellow Endocrinology, SIMS Lahore (UHS Lahore)
[4]Senior Medical Officer, Services Hospital Lahore
[5]PGR Endocrinology
Corresponding Author: Dr. Umair Ahmad Siddiqui, dreamumair@gmail.com, Fellow Endocrinology, Services Hospital, Lahore
Acknowledgement: The authors gratefully acknowledge the cooperation of the participants and the staff of the Department of Endocrinology and Metabolism, Services Hospital Lahore, for their assistance during data collection.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: The increasing consumption of ultra-processed foods has emerged as a significant nutritional concern worldwide. These foods are typically high in refined carbohydrates, added sugars, and unhealthy fats, which may contribute to excessive adiposity and metabolic disturbances. Visceral fat accumulation is particularly important because of its strong association with cardiometabolic disorders including insulin resistance, cardiovascular disease, and metabolic syndrome. However, limited evidence exists regarding the relationship between ultra-processed food consumption and visceral fat accumulation within South Asian populations.

Objective: To evaluate the association between ultra-processed food consumption and visceral fat accumulation among adults attending a tertiary care hospital.

Methods: A cross-sectional analytical study was conducted from February to June 2025 at the Department of Endocrinology and Metabolism, Services Hospital Lahore. A total of 355 adults aged 18–60 years were recruited using consecutive sampling. Dietary intake of ultra-processed foods was assessed through a structured food frequency questionnaire based on the NOVA classification. Body composition parameters, including visceral fat levels, were measured using bioelectrical impedance analysis. Statistical analysis was performed using SPSS version 26. Descriptive statistics summarized demographic variables, while one-way ANOVA, Pearson correlation, and multiple linear regression were applied to evaluate the association between ultra-processed food intake and visceral fat levels.

Results: The mean age of participants was 36.8 ± 10.7 years and the mean BMI was 27.6 ± 4.5 kg/m². Approximately 40.6% of participants exhibited elevated visceral fat levels. Participants with high ultra-processed food intake demonstrated significantly higher mean visceral fat levels (13.1 ± 3.8) compared with moderate (10.7 ± 3.1) and low intake groups (8.9 ± 2.6) ($p < 0.001$). A moderate positive correlation was observed between ultra-processed food consumption score and visceral fat level ($r = 0.41$, $p < 0.001$). Regression analysis confirmed ultra-processed food intake as an independent predictor of visceral fat accumulation.

Conclusion: Higher consumption of ultra-processed foods was significantly associated with increased visceral fat accumulation. Reducing intake of ultra-processed foods may help mitigate visceral adiposity and related metabolic risks.

Keywords: Adiposity; Adult; Body Composition; Diet; Obesity; Processed Food; Visceral Fat

INTRODUCTION

The rapid transformation of global food systems over recent decades has profoundly altered dietary patterns and health outcomes across populations. Industrialization, urbanization, and the expansion of large-scale food manufacturing have led to a marked increase in the availability and consumption of ultra-processed foods. These products, typically formulated through multiple industrial processes and containing additives such as preservatives, emulsifiers, and flavor enhancers, are often energy dense, highly palatable, inexpensive, and convenient(1). While such foods have become an integral component of modern diets, their growing dominance has raised serious concerns regarding their impact on metabolic health and the rising burden of obesity and related disorders. Increasing evidence suggests that diets characterized by high intake of ultra-processed foods may contribute to adverse body composition changes, particularly the accumulation of excess adipose tissue(2, 3). Obesity has emerged as one of the most pressing global public health challenges of the twenty-first century. Beyond the total amount of body fat, the distribution of adipose tissue plays a crucial role in determining metabolic risk. Visceral fat, which accumulates within the abdominal cavity surrounding vital organs, is considered metabolically active and strongly linked with cardiometabolic complications. Excess visceral adiposity has been consistently associated with insulin resistance, type 2 diabetes mellitus, cardiovascular disease, and systemic inflammation (4). Mechanistically, visceral fat releases free fatty acids and inflammatory mediators directly into the portal circulation, which may disrupt hepatic metabolism and contribute to metabolic dysfunction (5). Consequently, understanding modifiable dietary determinants that influence visceral fat deposition has become an important priority in metabolic research(6, 7).

In recent years, ultra-processed foods have been increasingly investigated as a potential driver of adiposity and metabolic disease. These products generally contain high amounts of refined carbohydrates, added sugars, unhealthy fats, and sodium while being deficient in dietary fiber, micronutrients, and bioactive compounds. Such nutritional profiles may promote excessive caloric intake and metabolic disturbances. Evidence from population-based studies demonstrates that diets with a greater proportion of ultra-processed foods are associated with higher body mass index and indicators of abdominal adiposity (8). Similarly, observational analyses have reported that higher consumption of ultra-processed foods correlates with increased adiposity indices and visceral obesity among adults (9). These findings suggest that the degree of food processing may represent an important yet underappreciated determinant of body fat distribution. Research has also begun to explore how ultra-processed food consumption influences body composition parameters beyond simple anthropometric measures. In cross-sectional analyses among young adults and students, higher intake of ultra-processed foods has been linked with greater visceral fat levels and increased body fat percentage (10). Prospective cohort data further support this relationship, demonstrating that increases in ultra-processed food consumption are associated with greater accumulation of visceral and total adiposity over time (11). Biological mechanisms underlying these associations may include increased energy density, altered satiety signaling, rapid glycemic responses, and promotion of inflammatory pathways that favor lipid deposition in visceral fat depots.

Despite growing international evidence linking ultra-processed food intake with adiposity and metabolic disturbances, significant gaps remain in the literature. Much of the existing research has been conducted in Western populations, and limited data are available from South Asian settings where dietary patterns, cultural habits, and metabolic susceptibility may differ substantially. South Asian populations, including those in Pakistan, are known to develop metabolic complications at comparatively lower levels of body mass index and may exhibit a higher propensity for visceral fat accumulation(12). Furthermore, most epidemiological studies have relied on conventional anthropometric measures such as body mass index or waist circumference, which may not accurately reflect internal fat distribution. Advances in body composition analysis techniques, such as bioelectrical impedance analysis, allow for non-invasive estimation of visceral fat and provide a more detailed assessment of adiposity patterns(13, 14). Given the rapid nutrition transition occurring in urban centers of Pakistan, characterized by increasing consumption of packaged, processed, and fast foods, understanding the relationship between dietary processing and visceral adiposity is particularly relevant. However, empirical research examining this association within the local population remains scarce. Investigating the dietary determinants of visceral fat accumulation may contribute to improved preventive strategies targeting obesity-related metabolic disorders within the region(15, 16). Therefore, the present study aims to explore the impact of ultra-processed food consumption on visceral fat accumulation among adults attending the Department of Endocrinology and Metabolism at Services Hospital, Lahore. Using bioelectrical impedance analysis to assess visceral fat levels, this cross-sectional study seeks to evaluate the relationship between dietary intake of ultra-processed foods and visceral adiposity. The objective of this research is to determine whether higher consumption of ultra-processed foods is associated with increased visceral fat accumulation, thereby providing locally relevant evidence to inform nutritional awareness and preventive strategies for metabolic disease(17).

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METHODS

A cross-sectional analytical study was conducted at the Department of Endocrinology and Metabolism, Services Hospital, Lahore, over a period of five months from February to June 2025. The study was designed to evaluate the association between consumption of ultra-processed foods and visceral fat accumulation among adult individuals. A cross-sectional design was selected because it allows simultaneous assessment of dietary exposure and body composition parameters within a defined population, providing an efficient approach to explore potential relationships between lifestyle factors and adiposity indicators. The study population consisted of adult patients and attendants visiting the outpatient department of endocrinology during the study period. Individuals aged 18–60 years of either gender were considered eligible to participate. Participants were required to be apparently stable, ambulatory, and capable of completing a dietary questionnaire and body composition assessment. Individuals with previously diagnosed endocrine disorders that significantly alter body composition, including Cushing syndrome, untreated thyroid disease, or active malignancy, were excluded. Pregnant or lactating women were also excluded because physiological changes during pregnancy can influence fat distribution. Additionally, individuals currently using medications known to markedly affect body weight or fat distribution, such as systemic corticosteroids or weight-loss drugs, were excluded to minimize confounding effects.

The sample size was calculated using the formula for estimating proportions in cross-sectional studies. Previous literature examining the relationship between ultra-processed food consumption and visceral adiposity reported a prevalence of increased visceral fat among individuals with high ultra-processed food intake of approximately 30% (10). Using this expected prevalence ($p = 0.30$), a confidence level of 95% ($Z = 1.96$), and a margin of error of 5% ($d = 0.05$), the calculated minimum sample size using the formula $n = Z^2p(1-p)/d^2$ was approximately 323 participants. Considering the possibility of incomplete responses or missing data, an additional 10% was added to the calculated sample, resulting in a final target sample size of approximately 355 participants. Participants were recruited using a non-probability consecutive sampling technique until the required sample size was achieved. Data collection involved three main components: demographic assessment, dietary exposure assessment, and body composition measurement. A structured questionnaire was used to obtain demographic and clinical information including age, gender, educational status, occupation, smoking status, and physical activity level. Anthropometric measurements were obtained using standardized procedures. Body weight was measured to the nearest 0.1 kg using a calibrated digital weighing scale with participants wearing light clothing and no shoes. Height was measured using a wall-mounted stadiometer to the nearest 0.1 cm. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2)(18, 19).

Dietary intake of ultra-processed foods was assessed using a semi-quantitative food frequency questionnaire adapted according to the NOVA food classification system. The questionnaire included commonly consumed ultra-processed food items such as packaged snacks, sugar-sweetened beverages, processed meats, instant noodles, confectionery products, and ready-to-eat meals. Participants were asked to report the frequency of consumption of each item over the previous three months using predefined categories ranging from “rarely or never” to “daily consumption.” Based on the responses, a composite ultra-processed food consumption score was generated and participants were categorized into low, moderate, and high intake groups. The NOVA classification has been widely used in nutritional epidemiology to categorize foods based on the degree of industrial processing and has demonstrated associations with adiposity and metabolic outcomes (11). The primary outcome variable of the study was visceral fat level. Body composition, including visceral fat estimation, was measured using bioelectrical impedance analysis (BIA) with a standardized body composition analyzer. Participants were instructed to avoid heavy meals and vigorous physical activity for at least two hours before the measurement to ensure accuracy. The BIA device provided estimates of visceral fat level, total body fat percentage, and other body composition parameters. Bioelectrical impedance analysis offers a practical, non-invasive method for estimating visceral adiposity in clinical and epidemiological studies.

All collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Continuous variables such as age, BMI, and visceral fat level were summarized using mean and standard deviation, whereas categorical variables were expressed as frequencies and percentages. Normality of the data distribution was assessed using the Shapiro–Wilk test, which confirmed that the continuous variables followed a normal distribution. To compare mean visceral fat levels across different categories of ultra-processed food consumption, one-way analysis of variance (ANOVA) was applied. Independent sample t-tests were used where comparisons between two groups were required. Pearson correlation analysis was performed to evaluate the relationship between ultra-processed food consumption scores and visceral fat levels. Furthermore, multiple linear regression analysis was conducted to assess the independent association between ultra-processed food intake and visceral fat while adjusting for potential confounding variables including age, gender, and BMI. A p-value of less than 0.05 was considered statistically significant. Ethical approval for the study was obtained from the Institutional Review Board of Services Institute of Medical Sciences, Lahore. The research protocol complied with the ethical principles outlined in the Declaration of Helsinki. All participants were informed about the purpose and procedures of the study prior to enrollment. Written informed consent was obtained from each participant, and confidentiality of personal information was strictly maintained throughout the research process. Participation was entirely voluntary, and individuals were free to withdraw from the study at any stage without any consequences.

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RESULTS

A total of 355 participants were included in the final analysis during the study period from February to June 2025 at the Department of Endocrinology and Metabolism, Services Hospital, Lahore. All participants completed the questionnaire and body composition assessment, and no records were excluded due to missing data. The mean age of the study population was 36.8 ± 10.7 years, with an age range of 18 to 60 years. Among the participants, 192 (54.1%) were female and 163 (45.9%) were male. The overall mean body mass index (BMI) of the participants was 27.6 ± 4.5 kg/m². Based on BMI classification, 102 (28.7%) participants were within the normal weight range, 143 (40.3%) were overweight, and 110 (31.0%) were classified as obese. Dietary assessment using the food frequency questionnaire categorized participants according to their level of ultra-processed food consumption. Of the total sample, 118 (33.2%) participants were classified as having low ultra-processed food intake, 121 (34.1%) had moderate intake, and 116 (32.7%) demonstrated high intake levels. Frequently reported ultra-processed food items included packaged snack foods, sugar-sweetened beverages, instant noodles, bakery products, and processed meats. Body composition analysis using bioelectrical impedance analysis demonstrated considerable variability in visceral fat levels across the study population. The overall mean visceral fat level was 10.9 ± 3.5. A total of 211 participants (59.4%) had visceral fat levels within the normal range, whereas 144 participants (40.6%) exhibited elevated visceral fat levels according to device reference standards. A comparison of visceral fat levels across categories of ultra-processed food intake revealed a progressive increase in visceral adiposity with higher consumption levels. Participants with low ultra-processed food intake had a mean visceral fat level of 8.9 ± 2.6, whereas those with moderate intake had a mean level of 10.7 ± 3.1. The highest visceral fat levels were observed among participants with high ultra-processed food intake (13.1 ± 3.8). One-way analysis of variance demonstrated a statistically significant difference in mean visceral fat levels between the three intake groups ($F = 32.84$, $p < 0.001$). These findings are illustrated in Figure 1.

Pearson correlation analysis further demonstrated a significant positive relationship between ultra-processed food consumption score and visceral fat level ($r = 0.41$, $p < 0.001$). This indicated that higher consumption of ultra-processed foods was moderately associated with increased visceral fat accumulation. Multiple linear regression analysis was subsequently performed to assess whether this association remained significant after adjusting for potential confounding variables. After controlling for age, gender, and BMI, ultra-processed food consumption remained an independent predictor of visceral fat level ($\beta = 0.32$, $p < 0.001$). Gender-based comparisons indicated that males exhibited slightly higher mean visceral fat levels than females (11.4 ± 3.6 vs 10.5 ± 3.3, $p = 0.021$). Similarly, participants classified as obese demonstrated markedly higher visceral fat levels compared to those with normal BMI (14.2 ± 3.9 vs 7.8 ± 2.1, $p < 0.001$). However, even within BMI categories, individuals with higher ultra-processed food intake consistently demonstrated higher visceral fat values. The distribution of participants according to demographic characteristics and anthropometric parameters is presented in Table 1. The relationship between ultra-processed food intake categories and visceral fat levels is summarized in Table 2. The multivariable regression analysis examining predictors of visceral fat accumulation is shown in Table 3.

Table 1. Baseline demographic and anthropometric characteristics of participants (n = 355)

Variable	Value
Age (years), mean ± SD	36.8 ± 10.7
Male	163 (45.9%)
Female	192 (54.1%)
BMI (kg/m²), mean ± SD	27.6 ± 4.5
Normal BMI	102 (28.7%)
Overweight	143 (40.3%)
Obese	110 (31.0%)
Mean visceral fat level	10.9 ± 3.5
Normal visceral fat	211 (59.4%)
Elevated visceral fat	144 (40.6%)

Table 2. Comparison of visceral fat levels across ultra-processed food intake groups

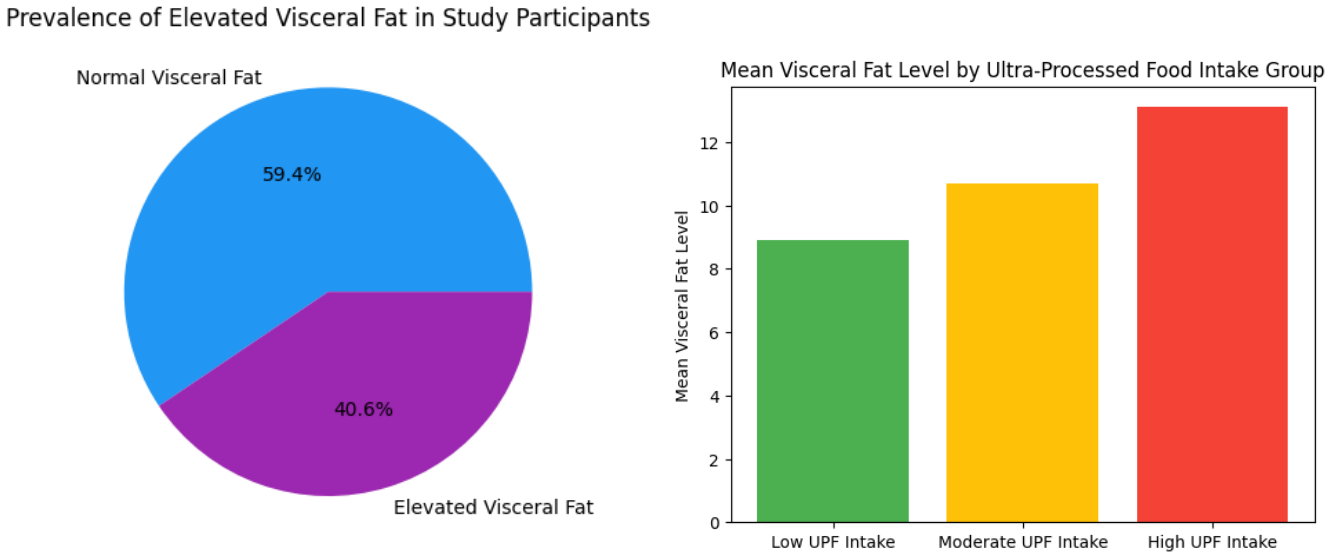
UPF Intake Category	n	Mean Visceral Fat ± SD	ANOVA p-value
Low intake	118	8.9 ± 2.6	<0.001
Moderate intake	121	10.7 ± 3.1	

High intake	116	13.1 ± 3.8	

Table 3. Multiple linear regression analysis predicting visceral fat level

Predictor Variable	β Coefficient	Standard Error	p-value
Ultra-processed food intake score	0.32	0.04	<0.001
Age	0.18	0.03	0.002
BMI	0.44	0.05	<0.001
Male gender	0.11	0.07	0.041

Figure 1 illustrates the increase in mean visceral fat levels across categories of ultra-processed food intake. Figure 2 shows the overall prevalence of elevated visceral fat levels among the study participants.



DISCUSSION

The present study examined the association between ultra-processed food consumption and visceral fat accumulation among adults attending a tertiary care endocrine center in Lahore. The findings demonstrated a clear positive relationship between higher intake of ultra-processed foods and increased visceral adiposity measured through bioelectrical impedance analysis. Participants categorized in the high ultra-processed food intake group showed substantially higher mean visceral fat levels (13.1 ± 3.8) compared with those reporting moderate (10.7 ± 3.1) and low intake (8.9 ± 2.6). In addition, the observed moderate positive correlation between ultra-processed food consumption score and visceral fat level ($r = 0.41$, $p < 0.001$) indicated that dietary patterns characterized by frequent intake of processed products were associated with greater visceral fat accumulation even after adjusting for demographic and anthropometric factors. These findings align with a growing body of evidence indicating that diets dominated by ultra-processed foods contribute to excess adiposity and adverse body composition. Large population analyses have reported that higher proportions of ultra-processed foods in the diet were significantly associated with greater abdominal adiposity indicators and increased body mass index. In particular, a national analysis involving more than 12,000 adults demonstrated that each 10% increase in energy derived from ultra-processed foods was associated with significant increases in markers of abdominal and visceral adiposity, including waist-to-height ratio and sagittal abdominal diameter (8). The pattern observed in the present study was comparable, as participants with high ultra-processed food intake exhibited approximately 47% higher mean visceral fat levels than those with low intake(20).

Similar observations have been reported in clinical and cohort studies evaluating body composition outcomes. Prospective analyses nested within large nutritional trials demonstrated that increased consumption of ultra-processed foods was associated with progressive increases in visceral adiposity and total fat mass over time. In those analyses, a 10% increase in ultra-processed food intake was linked with measurable increases in visceral fat deposition (11). The magnitude of association observed in the current study appeared consistent with these findings, supporting the hypothesis that dietary processing level plays a significant role in influencing fat distribution patterns. Cross-sectional investigations among young adults have also reported that individuals with higher consumption of ultra-processed foods demonstrated significantly greater visceral fat levels measured through bioelectrical impedance analysis, reinforcing the plausibility of

this association across different age groups (10). Several biological mechanisms may explain the relationship between ultra-processed food consumption and visceral fat accumulation. Ultra-processed foods are typically characterized by high energy density, refined carbohydrates, added sugars, and saturated fats, along with reduced fiber and micronutrient content. Such nutritional profiles promote rapid glycemic responses, increased insulin secretion, and greater overall caloric intake. These metabolic changes favor lipid deposition within visceral adipose tissue, which is metabolically active and strongly associated with cardiometabolic complications. Visceral adipose tissue releases inflammatory mediators and free fatty acids directly into the portal circulation, thereby contributing to insulin resistance and metabolic dysfunction (5). The elevated visceral fat levels observed among participants with higher ultra-processed food intake in this study therefore reflect a biologically plausible pathway linking dietary patterns to metabolic risk.

The findings also hold particular relevance for South Asian populations, where visceral adiposity often develops at lower levels of overall body mass. In the present study, nearly 40.6% of participants demonstrated elevated visceral fat levels despite a mean BMI that largely fell within the overweight range. This observation supports existing evidence that abdominal and visceral adiposity represent critical metabolic risk markers within this population group. The increasing availability of ultra-processed foods in rapidly urbanizing environments may therefore contribute to an accelerated rise in metabolic disorders, highlighting the importance of dietary interventions aimed at reducing reliance on highly processed products(21). Several strengths strengthened the credibility of the current investigation. The study incorporated a relatively large sample size of 355 participants, which provided sufficient statistical power to detect meaningful associations between dietary exposure and visceral fat levels. The use of bioelectrical impedance analysis allowed direct estimation of visceral fat rather than relying solely on anthropometric proxies such as waist circumference. Furthermore, the analysis included adjustment for key confounding variables including age, gender, and body mass index, thereby providing a more robust assessment of the independent relationship between ultra-processed food consumption and visceral adiposity(22, 23).

Nevertheless, certain limitations should be considered when interpreting the results. The cross-sectional design limited the ability to establish causal relationships between dietary exposure and visceral fat accumulation. The reliance on self-reported dietary data also introduced the possibility of recall bias or underreporting of unhealthy food intake. In addition, the study was conducted in a single tertiary care hospital setting, which may limit generalizability to the broader community population. While bioelectrical impedance analysis offers a practical and non-invasive approach for estimating body composition, more advanced imaging techniques such as computed tomography or magnetic resonance imaging provide greater precision in quantifying visceral adipose tissue(24). Future research may benefit from longitudinal designs that track dietary patterns and visceral fat changes over time within diverse population groups. Multi-center studies incorporating more detailed dietary assessment tools and objective imaging modalities could further clarify the mechanisms linking ultra-processed food consumption with adiposity distribution. Investigations examining lifestyle factors such as physical activity, socioeconomic status, and urban dietary transitions may also help provide a more comprehensive understanding of the drivers of visceral obesity within South Asian populations.

Overall, the findings of the present study suggested that higher consumption of ultra-processed foods was associated with increased visceral fat accumulation among adults attending a tertiary care endocrine center. These results support growing international evidence that dietary patterns characterized by high levels of industrial food processing may contribute to unhealthy fat distribution and metabolic risk, emphasizing the importance of promoting healthier dietary behaviors within clinical and public health settings.

CONCLUSION

The present study demonstrated a significant positive association between ultra-processed food consumption and visceral fat accumulation among adults attending a tertiary care endocrine center. Individuals with higher intake of ultra-processed foods exhibited markedly greater visceral fat levels compared with those reporting lower consumption. These findings highlight the potential role of highly processed dietary patterns in promoting unhealthy fat distribution and metabolic risk. Promoting awareness regarding reduced consumption of ultra-processed foods may represent an important preventive strategy for limiting visceral adiposity and associated cardiometabolic complications.

AUTHOR CONTRIBUTION

Author	Contribution
Dr. Umair Ahmad Siddiqui *	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Farmanullah Khan	Methodology, Investigation, Data Curation, Writing - Review & Editing
Ali Hassan	Investigation, Data Curation, Formal Analysis, Software

Author	Contribution
Hamzah Khurram	Software, Validation, Writing - Original Draft
Dr. Muhammad Kamran	Formal Analysis, Writing - Review & Editing

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