

Frequency of Ultra-Processed Food Consumption and Its Contribution to Daily Energy and Macronutrient Intake in Young Adults

Genç Yetişkinlerde Aşırı İşlenmiş Gıda Tüketim Sıklığı ve Günlük Enerji ile Makro Besin Ögesi Alımına Katkısı

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ABSTRACT

Obesity is a major public health problem today and is increasingly prevalent among young adults. Frequent and excessive consumption of ultra-processed foods (UPF) contributes to the development of obesity and other related health problems. Therefore, the aim of this study is to determine the frequency of UPF consumption and its contribution to daily energy and macronutrient intake in young adults. Data were collected through an online survey, which included socio-demographic characteristics and food frequency questionnaires in accordance with the UPF classification in the literature. The contribution of UPF consumption to daily energy and macronutrient intake was calculated based on food consumption frequency. This study included 225 young adults (61.3% female and 38.7% male). The average body mass index (BMI) of participants was $24.5 \pm 4.57 \text{ kg/m}^2$. The proportion of participants consuming sugary carbonated beverages ≥ 1 time/week was 32.6% among normal-weight participants and 48.8% among overweight/obese participants ($p=0.016$). Insignificant differences were found in frequently consumed UPFs such as sucuk, cream cheese, bakery products, mayonnaise, chocolate spread, candy, and chocolate by BMI ($p>0.05$). Energy ($\rho=0.19$, $p=0.004$), protein ($\rho=0.17$, $p=0.011$), fat ($\rho=0.20$, $p=0.003$), carbohydrate ($\rho=0.18$, $p=0.006$), saturated fatty acids ($\rho=0.22$, $p=0.001$), and cholesterol ($\rho=0.20$, $p=0.003$) intakes from UPFs were weakly and positively correlated with BMI. In conclusion, UPFs contributed approximately 30% of total daily energy intakes among young adults, while sugary carbonated beverage consumption and saturated fatty acid intake from UPFs were higher among overweight/obese participants. Developing healthy eating habits among young adults is crucial for preventing obesity and other chronic diseases today and in the future.

Keywords: Energy intake, Obesity, Ultra processed foods, Young adults

Öz

Obezite günümüzde önemli bir halk sağlığı sorunudur ve genç yetişkinler arasında giderek yaygınlaşmaktadır. Aşırı işlenmiş gıdaların (AİG) sık ve fazla miktarda tüketimi obezite ve ilişkili diğer sağlık sorunlarının gelişimine katkıda bulunmaktadır. Bu nedenle, bu çalışmanın amacı genç yetişkinlerde AİG tüketim sıklığını ve bunların günlük enerji ve makro besin ögesi alımına katkısını incelemektir. Veriler, sosyo-demografik özellikleri ve literatürdeki AİG sınıflamasına uygun şekilde besin tüketim sıklığını içeren çevrimiçi anket aracılığıyla toplanmıştır. Besin tüketim sıklığından AİG'nin günlük enerji ve makro besin ögesi alımına katkısı hesaplanmıştır. Çalışmaya 225 genç yetişkin (kadın %61,3 ve erkek %38,7) dahil edilmiştir. Katılımcıların ortalama beden kütle indeksi (BKİ) $24,5 \pm 4,57 \text{ kg/m}^2$ dir. Normal ağırlığa sahip katılımcılarda şekerli gazlı içecek tüketim sıklığı haftada ≥ 1 kez için %32,6 iken, fazla kilolu/obez katılımcılarda bu oran %48,8'dir ($p=0,016$). Sık tüketilen sucuk, krem peynir, unlu mamuller, mayonez, sürülebilir çikolata, şekerleme ve sütlü çikolata gibi AİG'ler için BKİ'ye göre anlamlı bir fark bulunmamıştır ($p>0,05$). Aşırı işlenmiş besinlerden gelen enerji ($\rho=0,19$, $p=0,004$), protein ($\rho=0,17$, $p=0,011$), yağ ($\rho=0,20$, $p=0,003$), karbonhidrat ($\rho=0,18$, $p=0,006$), doymuş yağ asiti ($\rho=0,22$, $p=0,001$) ve kolesterol ($\rho=0,20$, $p=0,003$) alımı ile BKİ arasında pozitif yönde zayıf korelasyon belirlenmiştir. Sonuç olarak, genç yetişkinlerde AİG'lerin enerji ve makro besin ögesi alımına katkısının yaklaşık %30 oranında olduğu ve bazı AİG'lerin fazla kilolu/obez bireylerde daha yüksek olduğu belirlenmiştir. Genç yetişkinlerde sağlıklı beslenme davranışlarının geliştirilmesi günümüzde ve gelecekte obezite ve diğer kronik hastalıkların önlenmesinde büyük önem taşımaktadır.

Anahtar Kelimeler: Enerji alımı, Obezite, Aşırı işlenmiş gıdalar, Genç yetişkinler



INTRODUCTION

Obesity is a chronic and complex disease and a major public health problem defined by excessive fat accumulation that can impair health. In 2022, 43% of individuals aged 18 and over were overweight, and 17% were obese according to the World Health Organization [1]. Despite extensive prevention strategies, obesity prevalence continues to rise worldwide, largely driven by profound changes in dietary habits and food environments [2]. Over recent decades, traditional dietary patterns have shifted toward increased consumption of energy-dense, nutrient-poor foods, larger portion sizes, more frequent snacking, and sugar-sweetened beverages. These dietary transitions have created an obesogenic food environment that promotes excessive energy intake and increases the risk of obesity [3, 4]. One of the most prominent changes in modern dietary habits is the decline in home-prepared meals [5].

Ultra-processed foods are industrial formulations composed predominantly or entirely of substances extracted from foods or derived from food constituents, with little or no intact whole foods. The Food and Agriculture Organization (FAO) divides all foods into 4 categories in the NOVA classification according to the nature, scope, and purposes of the industrial processes. These are classified as unprocessed and minimally processed foods (vegetables, fruits, eggs, milk, etc.), processed culinary ingredients (butter, sugar, salt, etc.), processed foods (canned vegetables, fruit syrups, etc.), and UPFs (sugar/carbonated beverage, packaged breads, fast-food foods, etc.) [6]. Due to the convenience, attractiveness, and marketing of UPFs, these foods account for more than half of dietary energy intake, especially in high-income countries where diets are not based on fresh food preparation [7, 8]. On the other hand, consumption of UPFs is increasing rapidly in middle-income countries, including countries whose dietary cultures are based on freshly prepared meals [9, 10].

The decline in home cooking, together with the increasing adoption of Western dietary patterns characterized by high intakes of energy, fat, sugar, and salt, contributes to an obesogenic food environment and may play an important role in the development of obesity [11]. Studies have reported that UPFs increase the risk of cardiovascular diseases [12], metabolic syndrome and cancer [13], stimulate the glycemic response and have low satiety potential [14]. In addition, studies have reported a positive relationship between the UPF consumption frequency and obesity, with this relationship increasing dose-dependently [8, 15, 16]. It has been determined that as the energy from UPF increases in the diet, the intake of protein, fiber, vitamins A, C, D, E, zinc, potassium, magnesium, and calcium decreases, and the intake of carbohydrates, added sugar, sodium, and saturated fat increases [17, 18].

Young adults frequently use packaged products and fast-food restaurants for reasons such as quickly satisfying hunger, building a social circle, menu variety, ease access to ready-to-eat food, limited time to prepare home-cooked meals, and the fun of eating together [19].

Since eating habits and body mass during young adulthood can lead to many chronic health problems in later ages, it is very important to develop healthy eating habits during this period [20, 21]. Although the association between UPF consumption and obesity has been well established, evidence that simultaneously evaluates UPF consumption frequency, their quantitative contribution to daily energy and macronutrient intake, and their relationship with BMI remains limited, particularly among young adults. Moreover, dietary patterns and the types of UPFs commonly consumed may vary across cultural and geographical settings. Therefore, evaluating both food-specific consumption patterns and the nutritional contribution of UPFs in young adults may provide a more comprehensive understanding of their role in dietary intake and excess body weight. Accordingly, this study aimed to determine the frequency of UPF consumption and their contribution to daily energy and macronutrient intake, and to examine the associations between these foods and BMI among young adults.

MATERIALS and METHODS

Study Population

A total of 225 young adults, aged 19-34 years, participated in this study. A questionnaire was developed using Google Forms. Participants were recruited via convenience sampling by distributing the survey link on commonly used social media platforms (e.g., WhatsApp and Instagram). Individuals who accessed the survey link and met the eligibility criteria were invited to participate voluntarily. Sample size was calculated using G*Power version 3.1.9.4 (Germany) with 95% confidence interval and 0.05 type-I error. The inclusion criteria were being 19–34 years of age, volunteering to participate in the study, having internet access, being able to complete the online questionnaire, and not following a therapeutic diet that could substantially influence dietary intake. The exclusion criteria were BMI <18.5 kg/m² (underweight), currently following a therapeutic diet, incomplete questionnaire responses, and inability to complete the online questionnaire independently. Underweight individuals were excluded because they represent a distinct nutritional group with dietary characteristics and determinants of body weight that may differ from those of normal-weight and overweight/obese individuals. Excluding this group allowed a more homogeneous comparison of obesity-related dietary patterns. This study was conducted in accordance with the Declaration of Helsinki and was approved by the Burdur Mehmet Akif Ersoy University Ethics Committee (GO 2023/215).

Data Collection and Measurements

The volunteers who agreed to participate in the study were asked to complete a survey consisting of three sections. The survey included sociodemographic characteristics, health information, and food consumption frequency.

Participants' height and body weight were self-reported, and BMI was calculated as body weight (kg) divided by height squared (m^2). According to the World Health Organization BMI classification, individuals are classified as normal weight ($18.5\text{--}24.9\text{ kg/m}^2$), overweight ($25.0\text{--}29.9\text{ kg/m}^2$), or obese ($\geq 30.0\text{ kg/m}^2$). For the purposes of this study, participants were categorized into two groups: normal weight ($18.5\text{--}24.9\text{ kg/m}^2$) and overweight/obese ($\text{BMI} \geq 25.0\text{ kg/m}^2$), to facilitate comparisons between individuals with normal weight and those with excess body weight [22].

Participants' food consumption frequency during the previous month was assessed using a food frequency questionnaire. Detailed food consumption frequency data were collected to determine daily energy and macronutrient intake. Consumption frequency was classified as follows: every meal, every day, 5-6 times a week, 3-4 times a week, 1-2 times a week, once every 15 days, once a month, and never. However, for accurate statistical analysis, frequency was presented in two categories (≥ 1 time/week and < 1 time/week). The food consumption frequency questionnaire included 95 food items, including meat and meat products, legumes, oilseeds, vegetables and fruits, bread and cereals, milk and dairy products, sugary foods and beverages, packaged foods, fast foods, and other foods. According to the NOVA classification, foods are categorized into four groups based on the nature, extent, and purpose of food processing. These are classified as unprocessed and minimally processed foods, processed culinary ingredients, processed foods and ultra-processed foods [6]. To determine participants' frequency of UPF consumption classified as ultra-processed according to the NOVA classification were added to the food consumption frequency questionnaire [6]. Participants were also asked to report the amount of each food consumed per eating occasion, from which daily consumption amounts were estimated. The daily energy and nutrient intake of participants, and the amounts of energy and nutrients from UPFs, were calculated using the Nutrition Information Package Program (BeBIS, Version 8.1) [23].

Statistical Analyses

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Kolmogorov-Smirnov test. As the continuous variables were not normally distributed, between-group comparisons were performed using the Mann-Whitney U test and were presented as mean $\pm$ standard deviation, median, and interquartile range (IQR) in two-group comparisons. Nominal variables were analyzed using the Chi-Square test and presented as counts and percentages. Spearman's rank correlation coefficient (ρ) was used to evaluate the associations between variables. The strength of the correlation coefficients was interpreted [24]. A p -value < 0.05 was considered statistically significant.

RESULTS

The demographic characteristics of participants are presented in **Table 1**. Of the 225 young adults, 38.7% were male, and 61.3% were female. The average age of the participants was 24.6 ± 3.95 years, and BMI was $24.5 \pm 4.57\text{ kg/m}^2$. Most of the participants were university graduates (54.2%) and single (83.6%). Overall, 44.9% of participants reported eating outside the home 2-4 times per week.

Table 1. Socio-demographic characteristics of participants (n=225)

Demographic Characteristics	N	Ratio (%)
Gender		
Female	138	61.3
Male	87	38.7
BMI classification		
Normal weight	141	62.7
Overweight/obese	84	37.3
Marital Status		
Married	37	16.4
Single	188	83.6
Education status		
High school and below	83	36.9
University	122	54.2
Postgraduate	20	8.9
Occupation		
Working	82	36.4
Not working	24	10.7
Student	119	52.9
Frequency of Eating out of Home		
0-1 times a week	106	47.1
2-4 times a week	101	44.9
5 or more time a week	18	8.0
Age (years) (Mean $\pm$ SD)	24.6 $\pm$ 3.95	
BMI (kg/m^2) (the lowest – the highest)	24.5 $\pm$ 4.57 (18.4 - 48.6)	

The distribution of participants' UPF consumption frequency by BMI classification is presented in **Table 2**. Sugary carbonated beverages were consumed ≥ 1 time/week by 32.6% of normal-weight participants and 48.8% of overweight/obese participants ($p=0.016$). No statistically significant difference was found in the other ultra-processed foods consumption frequency ($p>0.05$). Turkish sausage (sucuk) was consumed more than once per week by all participants (100%) in both groups and was therefore not included in **Table 2**.

The contribution of UPF consumption to energy and macronutrient intake according to the BMI classification is presented in **Table 3**. Saturated fatty acid intake from UPFs was significantly higher in overweight/obese participants than in normal-weight participants ($p=0.041$). Apart from this, no differences were found between the groups in the amounts and percentages of energy and macronutrients from the UPFs ($p>0.05$).

The relationship between energy and macronutrients intake from UPF and contribution to daily energy and nutrient intake of UPF and BMI was shown in **Figure 1**. When the amounts from UPF were examined, energy ($\rho=0.19$, $p=0.004$), protein ($\rho=0.17$, $p=0.011$), fat ($\rho=0.20$, $p=0.003$), carbohydrate ($\rho=0.18$, $p=0.006$), monounsaturated fatty acid ($\rho=0.18$, $p=0.006$), saturated fatty acid ($\rho=0.22$, $p=0.001$), cholesterol ($\rho=0.20$, $p=0.003$) intakes were weakly positively correlated with BMI. When the contribution (%) of UPF to total energy and macronutrients was examined, no statistically significant relationship was found ($p>0.05$).

Table 2. Distribution of ultra-processed food consumption frequency of participants according to body mass index classification

Foods and Beverages	Normal Weight				Overweight/Obese				Total				X ²	P
	≥1 time/week		<1 time/week		≥1 time/week		<1 time/week		≥1 time/week		<1 time/week			
	(%)		(%)		(%)		(%)		(%)		(%)			
	n	%	n	%	n	%	n	%	n	%	n	%		
Salami-sausage	25	17.7	116	82.3	13	15.5	71	84.5	38	16.9	187	83.1	0.191	0.662
Cream cheese	45	31.9	96	68.1	25	29.8	59	70.2	70	31.1	155	68.9	0.114	0.736
Bakery products	49	34.8	92	65.2	29	34.5	55	65.5	78	34.7	147	65.3	0.001	0.972
Bagel	42	29.8	99	70.2	24	28.6	60	71.4	66	29.3	159	70.7	0.038	0.846
Cereals	25	17.7	116	82.3	16	19.0	68	81.0	41	18.2	184	81.8	0.061	0.804
Margarine	22	15.6	119	84.4	19	22.6	65	77.4	41	18.2	184	81.8	1.739	0.187
Mayonnaise	42	30.0	98	70.0	30	35.7	54	64.3	72	32.1	152	67.9	0.786	0.375
Instant soup	7	5.0	134	95.0	10	11.9	74	88.1	17	7.6	208	92.4	3.630	0.057
Noodle	8	5.7	133	94.3	9	10.7	75	89.3	17	7.6	208	92.4	1.915	0.166
Ready-made French fries	19	13.5	122	86.5	9	10.7	75	89.3	28	12.4	197	87.6	0.368	0.544
Pita	15	10.6	126	89.4	9	10.7	75	89.3	24	10.7	201	89.3	0.000	0.986
Meat döner	12	8.5	129	91.5	8	9.6	75	90.4	20	8.9	204	91.1	0.082	0.775
Chicken döner	28	19.9	113	80.1	24	28.6	60	71.4	52	23.1	173	76.9	2.249	0.134
Chocolate dessert	31	22.0	110	78.0	28	33.3	56	66.7	59	26.2	166	73.8	3.504	0.061
Syrup dessert	7	5.0	134	95.0	10	11.9	74	88.1	17	7.6	208	92.4	3.630	0.057
Milky sweet	15	10.6	126	89.4	13	15.5	71	84.5	28	12.4	197	87.6	1.131	0.288
Chocolate spread	41	29.1	100	70.9	31	36.9	53	63.1	72	32.0	153	68.0	1.482	0.223
Chips	34	24.1	107	75.9	24	28.6	60	71.4	58	25.8	167	74.2	0.547	0.460
Milk chocolate	59	41.8	82	58.2	33	39.3	51	60.7	92	40.9	133	59.1	0.143	0.706
Dark chocolate	33	23.4	108	76.6	24	28.6	60	71.4	57	25.3	168	74.7	0.743	0.389
Wafer	32	22.7	109	77.3	23	27.4	61	72.6	55	24.4	170	75.6	0.626	0.429
Biscuit	28	19.9	113	80.1	25	29.8	59	70.2	53	23.6	172	76.4	2.867	0.090
Cake	23	16.3	118	83.7	17	20.2	67	79.8	40	17.8	185	82.2	0.555	0.456
Cracker	14	9.9	127	90.1	14	16.7	70	83.3	28	12.4	197	87.6	2.193	0.139
Candy	38	27.0	103	73.0	30	35.7	54	64.3	68	30.2	157	69.8	1.917	0.166
Fruit Milk	13	9.2	128	90.8	9	10.7	75	89.3	22	9.8	203	90.2	0.133	0.715
Fruit yoghurt	8	5.7	133	94.3	4	4.8	80	95.2	12	5.3	213	94.7	0.087	1.000
Iced tea	34	24.1	107	75.9	26	31.0	58	69.0	60	26.7	165	73.3	1.259	0.262
Sugary carbonated beverage	46	32.6	95	67.4	41	48.8	43	51.2	87	38.7	138	61.3	5.815	0.016
Creamy coffee	31	22.0	110	78.0	18	21.4	66	78.6	49	21.8	176	78.2	0.010	0.922

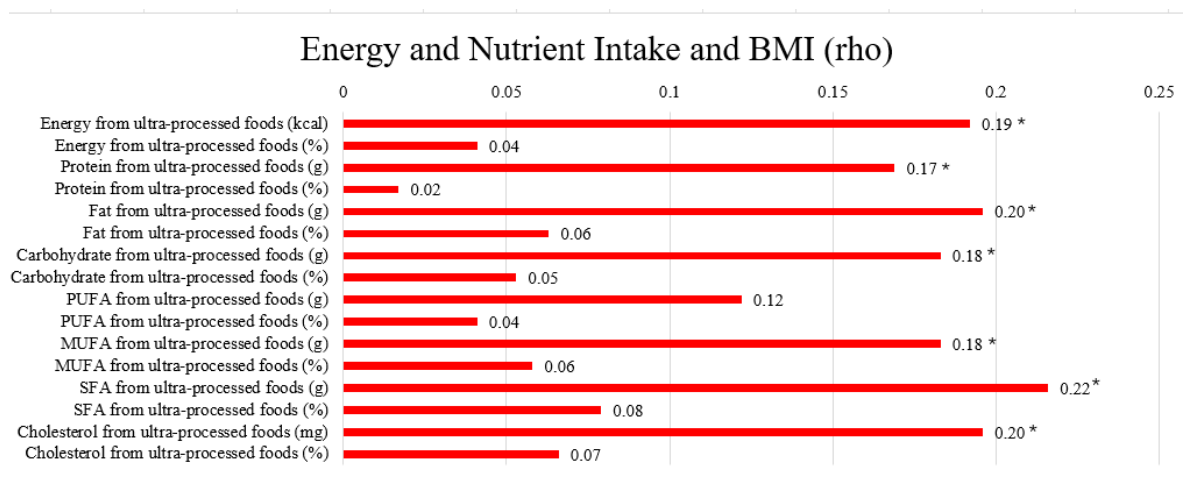
**Figure 1.** Correlations between energy and macronutrient intake from ultra processed foods and body mass index (rho values). Spearman's rank correlation analysis was used. *Significant at $p < 0.05$.

Table 3. Contribution to daily energy and nutrient intake of ultra-processed foods (UPFs) according to body mass index

Intake from UPFs	Normal Weight		Overweight/Obese		Total		U*	p
	Mean±SD	Median(IQR)	Mean±SD	Median(IQR)	Mean±SD	Median(IQR)		
Energy (kcal)	904.1±615.52	763.0 (678.0)	1137.2±850.53	927.0 (1063.0)	991.1±719.45	794.0 (811.5)	5092.0	0.079
(%)	30.5±13.03	29.1 (20.1)	30.0±13.80	28.9 (18.4)	30.3±13.30	29.1 (19.3)	5742.0	0.703
Protein (g)	22.5±14.92	18.0 (19.0)	28.5±22.12	22.0 (24.0)	24.7±18.13	19.0 (21.5)	5118.5	0.089
(%)	23.0±11.58	22.3 (15.1)	21.7±11.24	19.7 (14.0)	22.5±11.45	21.3 (14.8)	5477.5	0.347
Fat (g)	43.8±31.65	34.0 (36.5)	54.3±41.70	42.0 (47.0)	47.7±36.0	36.0 (40.0)	5120.0	0.089
(%)	28.7±13.76	27.0 (18.1)	29.2±15.21	29.2 (23.0)	28.9±14.28	27.8 (19.7)	5851.5	0.881
Carbohydrate (g)	104.4±73.13	84.0 (89.5)	134.8±99.67	113.0 (133.5)	115.8±85.09	91.0 (103.5)	5035.5	0.061
(%)	36.0±15.24	34.7 (22.9)	35.4±15.55	33.5 (24.5)	35.8±15.32	34.1 (23.1)	5761.5	0.734
PUFA** (g)	9.5±8.31	7.0 (8.0)	12.0±11.04	8.0 (12.8)	10.4±9.48	7.0 (9.0)	5382.5	0.252
(%)	31.3±17.54	29.2 (26.6)	32.5±19.17	29.2 (26.1)	31.7±18.13	29.2 (26.5)	5727.0	0.680
MUFA*** (g)	12.8±8.66	10.0 (10.0)	16.0±12.33	12.5 (13.8)	14.0±10.23	11.0 (12.0)	5156.0	0.104
(%)	26.7±13.00	26.2 (18.2)	27.4±14.89	26.8 (22.8)	27.0±13.71	26.2 (20.0)	5842.0	0.865
SFA**** (g)	18.1±13.53	14.0 (14.5)	23.3±18.30	18.0 (18.8)	20.0±15.65	16.0 (15.0)	4958.5	0.041
(%)	29.3±14.16	26.9 (19.9)	30.6±15.34	30.4 (22.4)	29.8±14.59	27.5 (20.3)	5674.0	0.600
Cholesterol (mg)	76.1±54.95	60.0 (64.0)	101.3±86.78	81.0 (87.3)	85.5±69.48	68.0 (74.0)	5003.0	0.052
(%)	16.3±10.07	15.3 (13.4)	18.0±12.79	15.7 (17.2)	16.9±11.16	15.3 (14.8)	5662.0	0.582

*Mann-Whitney U Test was used. **PUFA: Polyunsaturated Fatty Acids, ***MUFA: monounsaturated fatty acids, ****SFA: Saturated fatty acids

DISCUSSION

This study investigated the frequency of UPFs consumption, its contribution to daily energy and macronutrient intake, and their associations with BMI among young adults. Unlike many previous studies that have primarily focused on overall UPF consumption or obesity risk, this study simultaneously evaluated food-specific UPF consumption patterns together with the quantitative contribution of UPFs to daily energy and macronutrient intake. The findings showed that UPFs contributed approximately 30% of total daily energy intake, sugary carbonated beverages were consumed more frequently by overweight/obese participants, saturated fatty acid intake from UPFs was significantly higher in the overweight/obese group, and the amounts of energy, protein, fat, carbohydrate, MUFA, saturated fatty acids, and cholesterol derived from UPFs were weakly positively correlated with BMI. These findings provide a more comprehensive understanding of how different aspects of UPF consumption are associated with body weight in young adults in Türkiye.

Consumption of UPF is increasing rapidly worldwide. High consumption of these foods is associated with major health consequences such as obesity, type 2 diabetes, cardiovascular disease, and cancer [25]. Sugar, one of the most important components of UPF, has been shown to be associated with various health problems,

including obesity, diabetes, cardiovascular diseases, hyperuricemia, gout, fatty liver, dental caries, and some cancers [26]. In a study conducted among young adult women in Saudi Arabia, 30.2% of participants consumed carbonated beverages daily, and BMI, body weight, body fat, and waist circumference were positively correlated with carbonated beverage consumption [27]. In the present study, consumption of sugary carbonated beverages was more frequent among overweight/obese participants than among normal-weight participants ($p=0.016$). In addition, the amount of sugary-carbonated beverages consumed was lower among normal-weight participants (35.0 ± 56.0 mL) than that among overweight/obese participants (73.0 ± 104.0 mL) ($p=0.02$). Previous experimental evidence suggests that carbon dioxide in sugar-free or sugary carbonated beverages may stimulate ghrelin release, thereby increasing food intake. Increased ghrelin levels following carbonated beverage consumption have also been reported in male students [28]. Pressurized carbon dioxide in carbonated beverages may interact with the gastric wall and stimulate ghrelin release, potentially through mechanosensitive pathways. Pressure on cell membranes has been reported to trigger the release of signaling molecules, including serotonin from gastrointestinal enterochromaffin cells and parathyroid hormone-related peptide from coronary endothelial cells. Furthermore, the downstream effects of ghrelin may be modulated through interactions with serotonin 2C receptors. Collectively, these findings suggest that

CO₂ may contribute to ghrelin release through mechanosensitive mechanisms [29-31]. However, hormone levels were not assessed in the present study, and the cross-sectional design precludes causal inference. Therefore, the potential involvement of ghrelin should be considered a mechanism suggested by previous evidence rather than one directly demonstrated by the present findings.

Beyond individual UPF consumption, their overall contribution to daily energy intake provides an important perspective on the extent of UPF exposure. UPFs account for a substantial proportion of daily energy intake in both developed and developing countries [6], with reported contributions ranging from approximately 36-59% in several European countries and the USA [7, 13, 32, 33]. Among university students, UPFs have been reported to account for 41.0% of daily energy intake [34], whereas in other populations, their contribution has been lower. For example, an Iranian study reported that the proportion of energy derived from UPFs was 24.0% among individuals aged <38 years and 16.4% among those aged ≥38 years [10]. Similarly, a Korean study among adults aged 19-39 years reported that UPFs accounted for 34.8% of daily energy intake and 35.9% of saturated fat intake [35]. In the present study, UPFs accounted for approximately 30% of total daily energy and saturated fatty acid intake. Differences in age and cultural dietary patterns may partly explain the variation across studies. In particular, traditional dietary patterns in Türkiye retain several characteristics of the Mediterranean diet [36,37], which may contribute to a lower proportion of energy derived from UPFs than in some Western populations.

The literature suggests that socioeconomic status may play an important role in UPF consumption patterns [38]. However, the direction of this association appears to vary according to a country's income level. In high-income countries, higher UPF consumption has generally been associated with lower socioeconomic status, whereas in low- and middle-income countries, UPF consumption may be higher among individuals with greater income [9]. Türkiye is currently classified as an upper-middle-income country [39]; therefore, socioeconomic factors may be particularly relevant when interpreting UPF consumption patterns in this population. However, individual or household income was not assessed in the present study. Consequently, the potential influence of participants' income on UPF consumption and its contribution to daily energy and nutrient intake could not be evaluated.

Beyond differences in the overall level and sociodemographic patterning of UPF consumption, the potential relationship between UPF consumption and excess body weight is of particular importance. Rauber et al. [16] studied the relationship between UPF consumption and obesity in 6143 participants aged 19-96 years in the UK population and reported that a 10% increase in UPF consumption was associated with a 0.38 kg/m² increase in BMI and an 18% increase in the obesity rate. In a population-based study conducted in France, UPF consumption was associated with

obesity, and a 10% increase in the proportion of UPFs in the diet was associated with 1.10 and 1.09-fold increases in the risk of overweight and obesity, respectively [40]. In a study conducted in Brazil, it was reported that participants aged 20-39 years were more likely to be obese (OR=1.53, CI=0.76-3.06, p=0.08) with a higher proportion of energy from UPF (>45%) than individuals with a lower proportion (≤13%) [41]. In a study conducted in the United States, the energy intake from UPFs accounted for 56.1% of total energy among participants aged 20-64 years. It was stated that high UPF consumption (74.2%-100% of energy) was associated with a 1.61 unit increase in BMI compared with low consumption (≤36.5% of energy) [42]. In this study, the contribution of UPF to energy intake in young adults was estimated at 30% on average. Although there was no significant difference in the percentage of energy from UPFs across BMI groups, a weak positive correlation was observed between the amount of energy derived from UPFs and BMI. Western dietary patterns are generally characterized by greater consumption of processed and packaged foods than traditional dietary patterns in Türkiye. The convenience of consumption, ubiquity, affordability, large portion sizes, and effective marketing of UPFs encourage constant snacking and involuntary overeating. Consequently, UPFs may displace less processed, micronutrient-rich foods from the diet and adversely affect overall diet quality [43]. UPFs generally contain high energy per gram, are rich in added sugars and saturated fats, and are deficient in satiety-providing nutrients. They are also often designed to have appetizing properties, such as salt content and texture, which can encourage poor eating behaviors such as overeating and high energy intake. These characteristics may promote increased energy intake, thereby contributing to excess weight gain [14]. However, total energy and macronutrient intakes were not evaluated relative to individual requirements or recommended intake levels in the present study; therefore, these findings should not be interpreted as evidence of excessive overall energy or nutrient intake. An interesting finding of the present study was the positive correlation between protein and MUFA intake from UPFs and BMI. Although protein is generally considered a satiating nutrient, this finding likely reflects the characteristics of the protein sources rather than a protective effect of protein itself. In this population, a considerable proportion of protein derived from UPF may originate from processed meat products, packaged bakery products containing cheese or processed meat, ready-to-eat meals, and other energy-dense UPFs. These foods typically provide protein together with high amounts of saturated fat, sodium, refined carbohydrates, and energy. Therefore, the observed association is more likely to indicate greater consumption of energy-dense ultra-processed products than a detrimental effect of protein intake itself. This interpretation is further supported by the significantly higher intake of saturated fatty acids from UPFs among overweight/obese participants. In industrially processed foods, MUFA is commonly derived from vegetable oils incorporated into

products such as ready-to-eat meals, processed meat products, bakery products, and fast foods. Therefore, the observed association most likely represents higher overall consumption of energy-dense UPFs rather than an independent effect of MUFA intake.

This study has several strengths, including the simultaneous evaluation of food-specific UPF consumption frequency, the quantitative contribution of UPFs to daily energy and macronutrient intake, and their associations with BMI among young adults using the NOVA classification. The focus on young adults is also noteworthy, as dietary habits established during this life stage may influence subsequent health and body weight. However, several limitations should be acknowledged. The cross-sectional design precludes causal inference, and convenience sampling may have introduced selection bias, limiting the generalizability of the findings. Body weight and height were self-reported, while other indicators of adiposity, such as waist circumference and body fat percentage, were not assessed. Dietary intake was evaluated using a food frequency questionnaire and may therefore be subject to recall and reporting bias; prospective multiple-day food records may provide more precise quantitative estimates of UPF intake. In addition, potential confounding factors, including age, sex, education level, and socioeconomic status, were not controlled for in multivariable analyses. Micronutrient intake was also not assessed, as the study focused on energy and macronutrients derived from UPFs. Future studies should use larger, more diverse samples, prospective designs, objective anthropometric measurements, detailed dietary assessments, and multivariable regression analyses to provide a more comprehensive evaluation of UPF consumption and its relationship with BMI.

CONCLUSION

This study showed that the consumption of UPFs contributed approximately 30% of total daily energy intake among young adults. Although most UPF consumption frequencies and the percentage contributions of UPFs to energy and macronutrient intake did not differ significantly between BMI groups, several noteworthy findings emerged. Overweight/obese participants consumed sugary carbonated beverages more frequently and had a higher intake of saturated fatty acids from UPFs than normal-weight participants. Furthermore, the amounts of energy, protein, fat, carbohydrate, MUFA, saturated fatty acids, and cholesterol derived from UPFs were weakly positively correlated with BMI. The absence of significant differences in several UPF-related variables between BMI groups may partly reflect population-specific characteristics, including cultural differences in dietary habits and the present study's focus on young adults. In addition, dietary behaviors during young adulthood may differ from those observed in broader adult populations.

Nevertheless, the present findings highlight the substantial contribution of UPFs to the diets of young adults and suggest that reducing the consumption of energy-dense UPFs, particularly sugary carbonated beverages and foods contributing high amounts of saturated fat, should be considered in strategies aimed at promoting healthier dietary patterns and preventing excess weight gain in young adults.

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