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Research Article

Associations between ultra-processed food consumption, sleep quality, and chronotype

Eda KESKİN, **Betül YILMAZER**, **Ebrar ÇALIŞ**

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Istanbul Medipol University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Istanbul, Türkiye

ORCID IDs of the authors:
E.K. 0000-0001-7050-9337
B.Y. 0009-0008-6997-7932
E.Ç. 0009-0005-3148-4145

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Correspondence:
Eda KESKİN
E-mail: dyt.edakeskin@gmail.com

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ABSTRACT

This study examined the associations between ultra-processed food (UPF) consumption, sleep quality, and chronotype. This cross-sectional study included 200 healthy adults, with data collected on demographic-health characteristics, anthropometric measurements, UPF consumption using the Screening Questionnaire of Highly Processed Food Consumption (sQ-HPF), sleep quality using the Pittsburgh Sleep Quality Index (PSQI), and chronotype using the Morningness–Eveningness Questionnaire (MEQ). Participants' mean age was 25.9±9.4 years; 54% were female. High UPF consumption was observed in 72.0% of participants, 74.0% had poor sleep quality, and 75.5% were classified as having an intermediate chronotype. High UPF consumers had higher PSQI scores (p=0.014) and lower MEQ scores (p=0.034) compared to low UPF consumers. In regression analyses, age was the only significant predictor of high UPF consumption; each one-year increase was associated with a 6% decrease in the likelihood of high consumption (OR=0.94, 95%CI:0.91–0.97, p<0.001). Sleep quality and chronotype were not independently associated with UPF consumption. In conclusion, high UPF consumption was common among the participants in this study and was inversely associated with age, whereas sleep quality and chronotype were not independent predictors. These findings underscore the need for further longitudinal studies to clarify the relationships between UPF consumption, sleep quality, and chronotype in diverse age groups.

Keywords: Highly processed foods, Sleep quality, Chronotype, Circadian rhythm, Dietary behaviour, Nutritional epidemiology

Introduction

Ultra-processed foods (UPFs) are industrially produced foods that are heavily processed to enhance their shelf stability, taste, and ease of consumption (Monteiro et al., 2019). Nutritionally, these products typically contain high amounts of added sugar, salt, saturated fat, and various additives, while being poor sources of fibre and essential micronutrients. A growing body of evidence has demonstrated that frequent consumption of UPFs is associated with adverse health outcomes, including obesity, cardiovascular diseases, and diabetes (Srour et al., 2019; Yılmaz, 2023). For example, Doğanay et al. reported that higher UPF consumption was associated with a higher prevalence of chronic diseases (Doğanay et al., 2023). With ongoing lifestyle transitions and the widespread adoption of unhealthy dietary habits, UPFs consumption has been steadily rising, representing an emerging threat to public health (Okyar et al., 2023).

Sleep plays a critical role in regulating physiological processes, balancing energy metabolism, and maintaining a healthy life. Sleep quality is a multidimensional concept assessed by dimensions such as time to fall asleep, sleep continuity, sleep depth, sleep duration, and feeling rested in the morning. (Yıldırım & Özçelik Ersü, 2023). While high sleep quality contributes positively to the overall health of the individual, low sleep quality can lead to deterioration in metabolic and psychological functions and an increase in the risk of obesity and cardiometabolic diseases (İlhan Algın et al., 2016). Additionally, poor sleep quality can cause negative changes in individuals' nutritional preferences, increasing their tendency towards high-calorie, low-nutrient foods (Kurt et al., 2023).

Another important element in understanding the relationship between sleep and nutrition is the circadian rhythm. Circadian rhythm is a system that regulates the body's biological clock and influences many vital functions, from the sleep-wake cycle to metabolic processes (Okyar et al., 2023; Sözlü & Şanlıer, 2017). Disruptions in this rhythm negatively affect meal timing and energy metabolism, leading to changes in appetite regulation and potentially causing individuals to turn to UPFs, especially those high in sugar and fat (Çalışkan & Akan, 2019; Kocar & Kübra Elçioğlu, 2022). Misalignment of circadian rhythms and inadequate sleep, particularly common among shift workers, have been shown to alter eating behaviours, increase UPF consumption, and contribute to obesity risk (Çakmak & Kızıl, 2018). Chronotype reflects an individual's circadian rhythm preference and represents an important behavioural manifestation of the circadian system (Heikkinen et al., 2025). Chronotype has been associated with unhealthy dietary behaviours, with evening chronotypes more likely to engage in irregular meal timing, late-night eating, and higher consumption of energy-dense and UPFs (Romanenko et al., 2024). Studies have shown that poor sleep duration and quality, as well as disruptions in circadian rhythm, affect leptin and ghrelin, the hormones controlling appetite, leading to increased energy intake and a tendency toward high-calorie food consumption (Chaput et al., 2023; Mazri et al., 2019; van der Merwe et al., 2022).

Today, changes in lifestyle and dietary habits directly affect individuals' health status, and the association between nutrition, circadian rhythm, and sleep quality is gaining increasing importance (Potter et al., 2016; Saidi et al., 2024). In this context, only a limited number of international studies have examined the relationship between UPF consumption, sleep quality, and circadian rhythm. The distinctive contribution of the present study lies in its holistic evaluation of these associations in healthy adults, specifically within a sample of Turkish adults. This study aimed to determine the association between UPF consumption, chronotype and sleep quality in healthy adults. We hypothesised that higher UPF consumption may be associated with poorer sleep quality and an evening chronotype.

Materials and Methods

Study Population and Design

The calculation of sample size was performed using G*Power software based on a point-biserial correlation model, with a power of 95%, α=0.05, and a moderate effect size of 0.3 according to Cohen's classification (Cohen, 1988). The calculation was based on identifying the associations between UPF consumption according to sleep quality and chronotype, with high UPF consumption as the primary outcome variable. Based on these assumptions, the minimum required sample size was 111 participants. Participants were selected through convenience sampling from the adult population residing in Istanbul-Türkiye. This cross-sectional study was conducted on 200 healthy adults living in Istanbul-Türkiye between February and May 2025.

Participants were excluded if they were below 18 or above 65 years of age; had a diagnosis of dementia or Alzheimer's disease; were illiterate; had visual or hearing impairments; were pregnant or breastfeeding; had a diagnosed sleep disorder under treatment; were following a prescribed diet; had prior education in healthy eating; worked night shifts or rotating shifts;

or had a diagnosed eating disorder or were receiving treatment for an eating disorder. Eligible participants were healthy adults between 18 and 65 years who agreed to participate and did not fulfil any exclusion criteria.

Ethical Approval

Ethical approval was obtained from the Istanbul Medipol University Non-Interventional Ethics Committee (Date: 20.02.2025, approval number: 231).

Data Collection Procedure

Data for the study were collected using a six-part survey form developed for this study. The form was structured to assess participants' demographic data (sex, age, education level, marital status, and job), health information (smoking status and diagnosed chronic diseases), anthropometric measurements, UPF consumption, sleep quality, and chronotype. Trained researchers administered the prepared survey form via face-to-face interviews following a standardised data collection protocol. All participants completed the questionnaires in the same sequence, and anthropometric measurements were obtained using uniform procedures. The interviews were carried out in a quiet and private setting, and each interview lasted approximately 20–25 minutes. To ensure a 100% completion rate for all included variables, the researchers reviewed each survey form in real time for completeness before concluding the interview session. Written informed consent was obtained from the participants included in the study before the survey was administered.

Measurements and Instruments

Anthropometric Data

The anthropometric data collected comprised body weight, height, body mass index (BMI), waist circumference (WC), hip circumference (HC), waist-to-hip ratio (WHR), and neck circumference (NC). Trained researchers obtained WC, HC, and NC using a non-elastic tape measure with an accuracy of 0.5 cm, following appropriate methodology and standardised procedures described in the literature (Ben-Noun et al., 2001; World Health Organization, 2008). However, body weight and height were self-reported by the participants. According to World Health Organization (WHO) standards, risk thresholds were defined as WC >94 cm for men and >80 cm for women, WHR ≥0.90 for men and ≥0.85 for women, and BMI values of <18.5 kg/m² (underweight), 18.5–24.9 kg/m² (normal), 25.0–29.9 kg/m² (overweight), and ≥30.0 kg/m² (obese) (World Health Organization, 2008). In addition, ≥37 cm in men and ≥34 cm in women were considered a risk indicator for overweight and obesity (Ben-Noun et al., 2001).

*S*creening Questionnaire of Highly Processed Food Consump-tion (sQ-HPF)

The Screening Questionnaire of Highly Processed Food Consumption (sQ-HPF) was used to determine UPF consumption. This scale was developed in 2022 by Martinez-Perez et al. (Martinez-Perez et al., 2022). The Turkish validity and reliability study was conducted by Erdoğan Gövez et al. in 2024 (Erdoğan Gövez et al., 2024). sQ-HPF is a short and practical measurement tool that aims to assess the consumption frequencies of 11 different UPF groups (fatty dairy products, fats, cured meats, sweets, snacks, sugary and artificially sweetened drinks, refined cereals, ready-to-eat products, sauces, additives, and fried foods) that participants have consumed in the last year. Consumption frequency categories were graded as follows: never consume, 1-2 times a week, 3-4 times a week, and every day. A yes answer to each item is worth 1 point. The total score ranges from 0 to 11 points. A total score of 6 and above indicates high consumption of processed foods. The daily processed food consumption rate is calculated by substituting the total score into the equation below: "UPF consumption (% g/day) = (3.465 x sQ-HPF score) + 12.354" (Erdoğan Gövez et al., 2024).

Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate individuals' sleep quality. This scale was developed by Buysse et al. in 1989 (Buysse et al., 1989), and its validity and reliability studies for the Turkish language were conducted by Ağargün et al. in 1996 (Agargün et al., 1996). The scale is composed of 24 items. The measure evaluates seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping pills, and daytime dysfunction. The component scores are summed to yield a total PSQI score (0–21). Each item is scored from 0 to 3. Each item is scored on a 0–3 scale. Scores ≤5 reflect good sleep quality, while those >5 reflect poor sleep quality (Agargün et al., 1996).

Morningness–Eveningness Questionnaire (MEQ)

Morningness–Eveningness Questionnaire (MEQ) was utilised as a measure of chronotype. This scale was developed by Horne and Östberg (1976) to determine morning or evening predispositions based on their modifiable biological rhythms (Horne & Ostberg, 1976). The Turkish version of the MEQ was validated and tested for reliability in 2005 by Pündük, Gür, and Ercan (Pündük et al., 2005). This 19-item instrument assesses whether individuals prefer to engage in activities earlier or later in the day. With a total score range of 16–86, chronotypes are determined as "evening" for scores ≤41, "intermediate" for scores 42–58, and "morning" for scores ≥59 (Pündük et al., 2005).

Statistical Analysis

The statistical analysis of the collected data was performed using SPSS (Statistical Package for Social Sciences) for Windows 25.0 (IBM Corp., Armonk, NY, USA) (IBM Corp, 2022). Quantitative data were presented as mean (X), standard deviation (SD), minimum and maximum values, while categorical data were reported as numbers (n) and percentages (%). Chi-square tests were performed to evaluate associations between categorical variables. Normality of quantitative data was checked with the One-Sample Kolmogorov-Smirnov test. Comparisons of variables according to sex and UPF consumption were performed using either Student's *t*-test or the Mann-Whitney U test. Relationships between variables were analysed using Spearman's correlation. Binary logistic regression was performed to examine the effects of sleep quality and chronotype on high UPF consumption. In the adjusted model, age and sex were included because both variables are consistently associated with dietary behaviours and UPF intake. Other variables, such as BMI, chronic disease status, and smoking, were not included in the multivariable model because they may lie on the causal pathway between UPF consumption and health outcomes, and their inclusion could result in overadjustment. Given the study's cross-sectional design and sample size, a parsimonious model was preferred to avoid model instability and multicollinearity. Statistically significant values were expressed as $p<0.05$.

Results and Discussion

Table 1 presents the demographic data of participants. A total of 200 adults were included in the study, with a mean age of 25.9 ± 9.4 years. Of these, 54% were female. The majority of participants had completed high school (66.5%) or university (27.0%), while only 3.0% held a postgraduate degree. Most participants were single (81.5%), and more than half were students (56.5%), followed by private sector employees (19.0%) and public servants (9.0%). Regarding lifestyle characteristics, 31.5% reported smoking, and 18.0% had at least one diagnosed chronic disease. The most frequently reported diseases were gastrointestinal diseases (8.0%), neurological diseases (3.5%), and thyroid disorders (2.5%). Anthropometric measurements showed a mean body weight of 68.3±14.8 kg, BMI of 23.2±3.8 kg/m², WC of 77.1±11.6 cm, HC of 97.1±9.3 cm, WHR of 0.8±0.1, and NC of 34.6±4.1 cm.

The mean sQ-HPF score was 6.7±2.3 for the total sample, with no significant difference between females and males (6.6±2.4 vs 6.9±2.2, respectively; $p=0.359$). Based on the sQ-HPF classification, 72.0% of participants were categorised as high UPF consumers and no significant difference between sexes (Table 2). UPF consumption was negatively correlated with age ($r=-0.314$, $p<0.001$) (Figure 1A). To determine potential factors associated with high UPF intake, logistic regression analyses were conducted. After adjusting for age and sex (Model 2), only age was found to be a significant predictor of high UPF consumption. Specifically, as age increased, the likelihood of consuming high UPF decreased (OR=0.94, 95% CI: 0.91–0.97, $p<0.001$) (Table 4). In summary, our results indicate that high UPF consumption is prevalent, particularly among younger participants, and decreases with age. Many cohort studies examining UPF consumption and its association with health outcomes have also examined sociodemographic factors, especially age, related to UPF consumption (Marino et al., 2021). A study carried out in Jakarta, Indonesia, found that younger individuals tended to consume more UPFs (Setyowati et al., 2018). Similarly, a systematic review of cohort studies from 17 countries examining the association between demographic characteristics and UPF consumption found a consistent association between younger age and higher UPF consumption (Dicken et al., 2024). Consistent with previous studies, younger age emerged as a significant predictor of higher UPF consumption in our sample. The high prevalence of UPF consumption among young adults may reflect global dietary trends, urban lifestyle, and convenience-driven eating habits. Alternatively, this pattern may also reflect cohort-related differences, whereby older individuals may have retained more traditional eating habits. In comparison, younger individuals may have been more exposed to an obesogenic food environment characterised by widespread availability and marketing of UPFs. These findings highlight the importance of early dietary interventions targeting younger adults to reduce excessive UPF consumption.

Table 1. Baseline demographics of participants

Variables	All Participants (n=200)
Age, years	25.9 ± 9.4 (18-61)
Sex	
Female	108 (54.0)
Male	92 (46.0)
Education level	
Primary school	1 (0.5)
Middle school	6 (3.0)
High school	133 (66.5)
University	54 (27.0)
Postgraduate	6 (3.0)
Marital status	
Single	163 (81.5)
Married	37 (18.5)
Job	
Public servant	18 (9.0)
Private sector employee Trades	38 (19.0)
Retired	13 (6.5)
Student	5 (2.5)
Unemployed	113 (56.5)
	13 (6.5)
Smoking	
Yes	63 (31.5)
No	137 (68.5)
Diagnosed with a chronic disease	
No	164 (82.0)
Yes*	36 (18.0)
Gastrointestinal diseases	16 (8.0)
Thyroid diseases	5 (2.5)
Cardiovascular diseases	4 (2.0)
Neurological diseases	7 (3.5)
Other (liver and kidney diseases)	3 (1.5)
Anthropometric measurements	
Body weight (kg)	68.3 ± 14.8 (40-120)
BMI (kg/m^2)	23.2 ± 3.8 (15.6-37.4)
BMI classification	
Underweight (<18.5 kg/m^2)	20 (10.0)
Normal (18.5-24.9 kg/m^2)	129 (64.5)
Overweight (25.0-29.9 kg/m^2)	41 (20.5)
Obese (≥30.0 kg/m^2)	10 (5.0)
WC (cm)	77.1 ± 11.6 (58-110)
Female	70.9 ± 9.1
No risk (≤80 cm)	96 (88.9)
High risk (>80 cm)	12 (11.1)
Male	84.4 ± 9.9
No risk (≤94 cm)	77 (83.7)
High risk (>94 cm)	15 (16.3)
HC (cm)	97.1 ± 9.3
WHR	0.8 ± 0.1 (0.6-1.2)
Female	0.7 ± 0.1
No risk (<0.85)	100 (92.6)
High risk (≥0.85)	8 (7.4)
Male	0.9 ± 0.1
No risk (<0.90)	73 (79.3)
High risk (≥0.90)	19 (20.7)
NC (cm)	34.6 ± 4.1 (25-50)
Female	32.1 ± 2.9
No risk (<34 cm)	77 (71.3)
High risk (≥34 cm)	31 (28.7)
Male	37.6 ± 3.2
No risk (<37 cm)	39 (42.4)
High risk (≥37 cm)	53 (57.6)

Data are presented as n (percentage) or mean ± standard deviation (min–max).
BMI: Body mass index, WC: Waist circumference, NC: neck circumference, HC: Hip circumference, WHR: Waist-to-hip ratio
* Participants were allowed to report more than one diagnosed chronic disease.

Regarding sleep quality, 74.0% of participants were classified as poor sleepers, while only 26.0% were good sleepers (Table 2). The mean PSQI score was significantly higher among females compared to males (7.3±3.4 vs 6.3±2.8, p=0.031) (Table 2). The prevalence of poor sleep quality was similar between high and low UPF consumers (77.1% vs. 66.1%, p=0.111). However, the mean PSQI score was higher in the high consumption group (7.2±3.3 vs 5.9±2.8, p=0.014) (Table 3). No significant correlations were observed between UPF consumption and PSQI total score (r=0.114, p=0.109) (Figure 1B). In the crude regression model (Table 4), no statistically significant association was observed between poor sleep quality and high UPF consumption compared with good sleep quality (OR=0.64, 95% CI: 0.32–1.27, p=0.199). Similarly, after adjusting for age and sex (Model 2), sleep quality (OR=0.64, 95% CI: 0.31–1.32, p=0.226) was not significantly associated with UPF consumption. Diet quality is often related to sleep quality; however, research examining the relationship between UPF consumption and sleep patterns is still emerging (Andreeva et al., 2023). A study of 66,791 Brazilian adolescents reported higher UPF consumption among those with insufficient sleep duration (Rocha et al., 2024). Similarly, a recent meta-analysis associated high UPF consumption with shorter sleep duration and poorer sleep quality (Delpino et al., 2023). Another study identified that higher UPF consumption is associated with increased insomnia rates (Duquenne et al., 2024). Although participants with higher UPF intake in our study reported significantly higher PSQI scores, no significant association was observed in correlation or regression analyses. The discrepancy between the group comparison and multivariable analyses may be explained by the inability of unadjusted tests, such as the *t*-test, to account for potential confounding factors, including age and sex. When these variables were considered in regression models, the association did not persist, suggesting that the observed group difference may reflect underlying demographic differences (age, sex) rather than a direct independent association between UPF consumption and sleep quality. Differences between our findings and previous studies may be explained by variations in study populations and UPF assessment methods (e.g., NOVA classification or screening tools). In addition, cultural or lifestyle factors such as social norms (e.g., late-night social activities), meal timing, and the frequent consumption of caffeinated beverages such as tea or coffee—common in Turkish culture—may influence both dietary patterns and sleep quality and may partly explain inconsistencies across studies.

Table 2. UPF consumption (sQ-HPF), sleep quality (PSQI), and chronotype (MEQ) outcomes according to sex

	Sex			
	Female (n=108)	Male (n=92)	p	Total (n=200)
Total sQ-HPF score†	6.6 ± 2.4 (1.0-11.0)	6.9 ± 2.2 (2.0-11.0)	0.359	6.7 ± 2.3 (1.0-11.0)
sQ-HPF classification§				
Low consumption (<6)	31 (28.7)	25 (27.2)	0.810	56 (28.0)
High consumption (≥6)	77 (71.3)	67 (72.8)		144 (72.0)
HPF consumption (% g/day)†	35.2 ± 8.3 (15.8-50.4)	36.3 ± 7.6 (19.3-50.5)	0.359	35.7 ± 8.0 (15.8-50.5)
Total PSQI score†	7.3 ± 3.4 (2.0-17.0)	6.3 ± 2.8 (1.0-15.0)	0.031*	6.8 ± 3.2 (1.0-17.0)
PSQI classification§				
Good sleeper (≤5)	26 (24.1)	26 (28.3)	0.501	52 (26.0)
Poor sleeper (>5)	82 (75.9)	66 (71.7)		148 (74.0)
Total MEQ score¥	48.1 ± 7.8 (28.0-67.0)	49.3 ± 7.5 (27.0-75.0)	0.248	48.7 ± 7.7 (27.0-75.0)
MEQ phenotypes§				
Evening (≤41)	23 (21.3)	10 (10.9)		33 (16.5)
Intermediate (42-58)	77 (71.3)	74 (80.4)	0.140	151 (75.5)
Morning (≥59)	8 (7.4)	8 (8.7)		16 (8.0)

Data are presented as n (percentage) or mean ± standard deviation (min–max). UPF: Ultra processed food, sQ-HPF: Screening Questionnaire of Highly Processed Food Consumption, PSQI: Pittsburgh Sleep Quality Index, MEQ: Morningness-Eveningness Questionnaire. * p<0.05. † Student's t-test; § Chi-square test; ¥ Mann-Whitney U test.

Table 3. Comparison of sleep quality and chronotype according to UPF consumption levels

	sQ-HPF classification		
	Low consumption (n=56)	High consumption (n=144)	p
Total PSQI score†	5.9 ± 2.8 (1.0-15.0)	7.2 ± 3.3 (1.0-17.0)	0.014*
PSQI classification§			
Good sleeper (≤5)	19 (33.9)	33 (22.9)	0.111
Poor sleeper (>5)	37 (66.1)	111 (77.1)	
Total MEQ score¥	50.5 ± 6.8 (35.0-67.0)	47.9 ± 7.9 (27.0-75.0)	0.034*
MEQ phenotypes§			
Evening (≤41)	5 (8.9)	28 (19.4)	
Intermediate (42-58)	46 (82.1)	105 (72.9)	0.198
Morning (≥59)	5 (8.9)	11 (7.6)	

Data are presented as n (percentage) or mean ± standard deviation (min–max). UPF: Ultra processed food, sQ-HPF: Screening Questionnaire of Highly Processed Food Consumption, PSQI: Pittsburgh Sleep Quality Index, MEQ: Morningness-Eveningness Questionnaire. * p<0.05. † Student's t-test; § Chi-square test; ¥ Mann-Whitney U test.

Table 4. Binary logistic regression test results for predictors of high UPF consumption

	Model 1					Model 2				
Predictor	**B**	**SE**	**OR**	**95% CI**	**p**	**B**	**SE**	**OR**	**95% CI**	**p**
Age	-	-	-	-	-	-0.064	0.018	0.94	0.905-0.972	<0.001**
Sex										
Female (Ref)	-	-	-	-	-	-	-	-	-	-
Male						0.415	0.346	1.51	0.768-2.982	0.231
PSQI										
Good sleeper (Ref)	-	-	-	-	-	-	-	-	-	-
Poor sleeper	-0.450	0.351	0.64	0.321–1.267	0.199	-0.443	0.366	0.64	0.313–1.315	0.226
MEQ phenotypes										
Evening	0.804	0.736	2.23	0.528–9.444	0.275	0.155	0.818	1.17	0.235-5.799	0.850
Intermedite (Ref)	-	-	-	-	-	-	-	-	-	-
Morning	-0.005	0.572	0.99	0.325–3.051	0.993	-0.714	0.671	0.49	0.131-1.824	0.287

UPF: Ultra processed food, PSQI: Pittsburgh Sleep Quality Index, MEQ: Morningness-Eveningness Questionnaire.
Model 1: Crude (unadjusted). Nagelkerke R^2 = 0.037; Hosmer–Lemeshow χ^2 = 6.85, p=0.077.
Model 2: Adjusted for age (continuous) and sex (categorical). Nagelkerke R^2 = 0.133; Hosmer–Lemeshow χ^2 = 8.71, p=0.368. ** p<0.001.

Based on the total MEQ score, most participants (75.5%) were intermediate chronotypes, followed by evening chronotypes (16.5%) and morning chronotypes (8.0%). The total MEQ score was 48.7±7.7, with no significant sex differences (p=0.248) (Table 2). The mean MEQ score was lower among high UPF consumers compared to low consumers (47.9±7.9 vs 50.5±6.8, p=0.034). There was no statistically significant difference in chronotype distribution between high and low UPF consumers (p=0.198) (Table 3). No significant correlations were observed between UPF consumption and MEQ total score (r=-0.094, p=0.187) (Figure 1C). As presented in Table 4, no statistically significant association was observed between evening chronotype and high UPF consumption compared with the intermediate chronotype (OR=2.23, 95% CI: 0.53–9.44, p=0.275). Similarly, after adjusting for age and sex (Model 2), chronotype (evening vs intermediate: OR=1.17, 95% CI: 0.24–5.80, p=0.850; morning vs intermediate: OR=0.49, 95% CI: 0.13–1.82, p=0.287) were not significantly associated with UPF consumption. Few studies have explored the association between UPF intake and circadian rhythm. In a study that investigated the relationship between chronotype and UPF consumption, evening-type participants were found to have a higher percentage of daily energy intake from UPFs, and chronotype score was negatively correlated with UPF consumption (Kabasakal Cetin, 2023). Similarly, a study of Korean adults found a significant association between UPF consumption and chronotype only among evening-type participants (Jeong et al., 2025). A systematic review suggested that late chronotypes tend to have less healthy eating patterns, including late-night eating and higher UPF consumption, whereas early chronotypes primarily consume fresh foods and have more regular eating times (Teixeira et al., 2022). In contrast to international findings, in our study, although individuals with high UPF consumption had significantly lower MEQ scores, no independent association between chronotype and UPF intake was observed. These different outcomes between the group comparison and multivariable analyses may be explained by the inability of unadjusted tests, such as the Mann-Whitney U test, to account for potential confounding factors, including age and sex. The differences between our findings and the studies in the literature may be attributed to sociocultural dietary patterns in Türkiye—where meal timing and food preparation practices differ from Western populations—or to the cross-sectional design, which limits causal inference. Additionally, in our study, the majority of participants were classified as having an intermediate chronotype, with relatively small proportions of evening and morning types, an uneven distribution that may have reduced the statistical power of categorical analyses and limited the ability to detect potential differences in UPF consumption across chronotype groups. Further studies with more balanced chronotype distributions are needed to clarify the potential role of circadian preference in UPF consumption patterns.

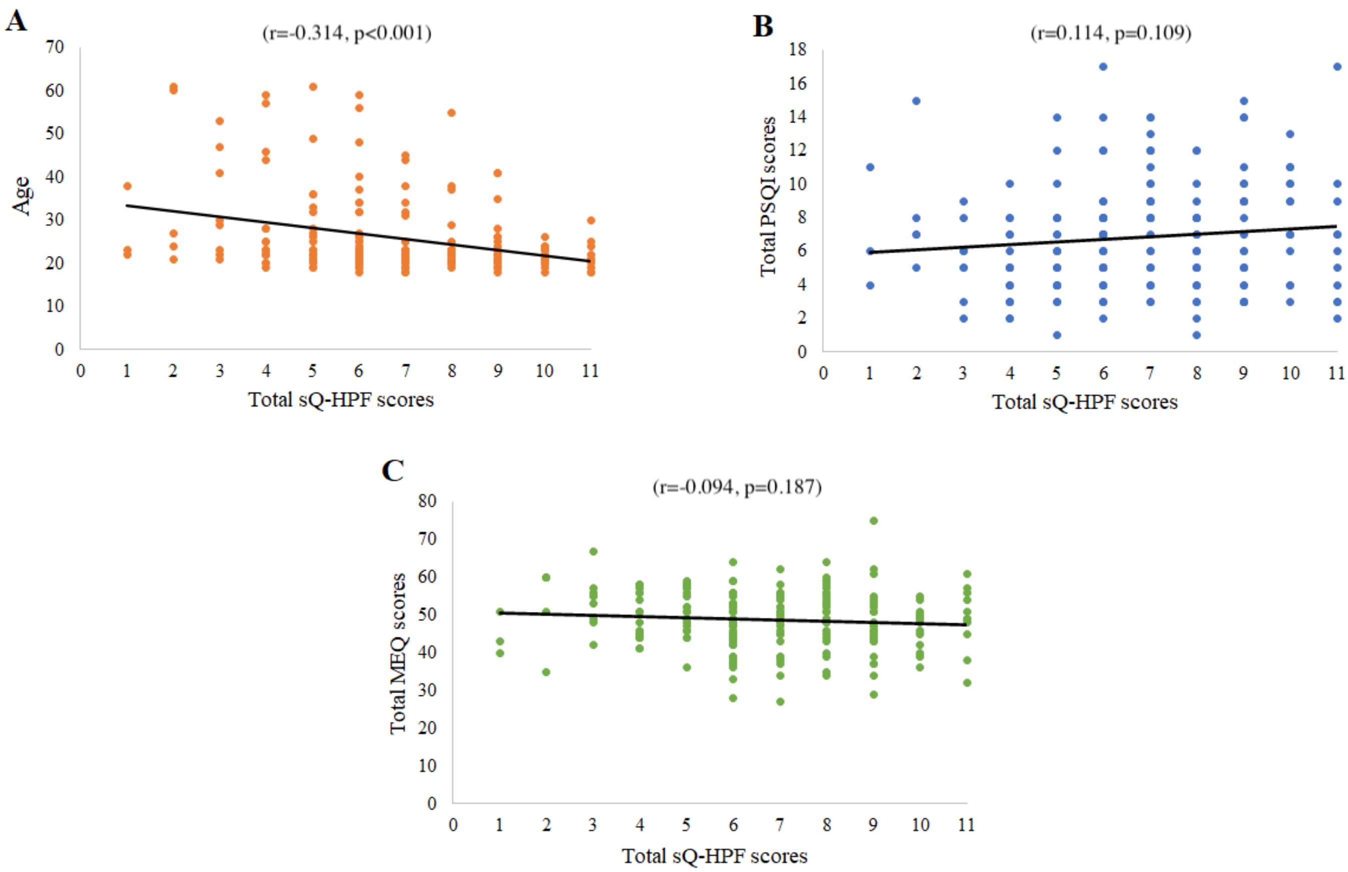

Figure 1. Correlations of HPF consumption with age (A), PSQI total score (B), and MEQ total score (C)

To our knowledge, this is among the first studies to jointly examine UPF consumption, sleep quality, and chronotype within a sample of Turkish adults. Strengths of this study include the use of validated instruments (sQ-HPF, PSQI, MEQ), face-to-face data collection, and some anthropometric measurements performed by trained researchers. However, there are some limitations to this study. First, the cross-sectional design precludes causal inference, while the relatively small sample size, the predominantly young age distribution of the sample, and the use of convenience sampling may have limited the representativeness and generalizability of the findings to the broader adult population. Therefore, the results should be interpreted within the context of the study sample rather than as population-level estimates. Moreover, although the sample size was sufficient to meet the study's statistical power requirements, the results cannot be generalised to the overall Istanbul population. Second, the use of self-reported body weight and height data may have introduced reporting bias. Third, UPF consumption, sleep quality, and chronotype were assessed using self-reported questionnaires, which may be subject to recall bias and reporting bias despite the use of validated instruments. Finally, residual confounding by unmeasured lifestyle factors such as stress, physical activity, or caffeine intake cannot be fully excluded. Future longitudinal or intervention studies are warranted to explore the directionality and underlying mechanisms linking UPF consumption, sleep quality, and chronotype.

Conclusion

This study demonstrates that high UPF consumption is prevalent among healthy adults, with younger age being a significant predictor. After adjustment for confounders, neither poor sleep quality nor evening chronotype was significantly associated with high UPF consumption. Given the cross-sectional design and sample characteristics, these findings reflect observed associations rather than establishing causal pathways. The findings highlight the need for early dietary interventions to promote healthier eating habits, particularly targeting younger populations. Future longitudinal and intervention studies should focus on clarifying the causal pathways and underlying mechanisms linking UPF consumption, sleep patterns, and chronotype.

Compliance with Ethical Standards

Conflict of interest: The author(s) declare that they have no actual, potential, or perceived conflicts of interest related to this article.

Ethics committee approval: Ethical approval was obtained from the Istanbul Medipol University Non-Interventional Ethics Committee (Date: 20.02.2025, approval number: 231).

Data availability: The data will be made available upon request by the author(s).

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