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Morning Affect, Eveningness, and Amplitude Distinctness: Associations with Sleep Parameters, Eating Habits, Dietary Intakes and Diet Quality of University Students: A Cross-Sectional Study

Sabah Etkisi, Akşamcılık ve Genlik Farklılığı: Üniversite Öğrencilerinin Uyku Parametreleri, Beslenme Alışkanlıkları, Diyet Alımları ve Diyet Kaliteleri ile İlişkisi: Kesitsel Bir Çalışma

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ABSTRACT Objective: Studies in the literature evaluated the association between personality traits, sleep quality, and negative emotionality, and the circadian rhythm components of morning affect, eveningness, and amplitude of diurnal variation (distinctness). Associations between sleep parameters, eating habits, dietary intake, and diet quality, and circadian rhythm components were explored in the current study. **Material and Methods:** A sample of 605 Turkish university students participated in this study and completed a preliminary questionnaire related to sociodemographic characteristics, sleep parameters, and eating habits, and The Morningness-Eveningness Stability Scale improved. Also, their dietary intake was assessed with 24-hour dietary recall method. **Results:** Morning affect was positively correlated with number of main meals and snacks, energy, protein, total fat, saturated fatty acids, monounsaturated fatty acids intakes, and consumption of eggs and nuts and negatively correlated with time to fall asleep during weekends, wake up time on weekdays and weekends. Distinctness generally showed the opposite associations. Eveningness exhibited positive associations with wake up time on weekdays and weekends, and negative associations with number of main meals and egg consumption. No statistically significant association was established between circadian rhythm components of morning affect, eveningness and amplitude of diurnal variation (distinctness), and diet quality of university students. **Conclusion:** Circadian rhythm components of morning affect and distinctness may both be more strongly related to dietary intakes of university students. Further research is needed to confirm these findings and establish the directions of possible causal relationships, which may help to develop personalised nutrition advice for university students.

Keywords: Morning affect; eveningness; distinctness; sleep; diet quality

ÖZET Amaç: Literatürde yer alan araştırmalar, kişilik özellikleri, uyku kalitesi ve negatif duygusallık ile sirkadiyen ritim bileşenleri sabah etkisi, akşamcılık ve günlük varyasyon genliği (farklılık) arasındaki ilişkiyi araştırmıştır. Bu çalışmada, uyku parametreleri, beslenme alışkanlıkları, diyet alımları ve diyet kalitesi ile sirkadiyen ritim bileşenleri arasındaki ilişki araştırılmıştır. **Gereç ve Yöntemler:** Bu çalışmaya 605 üniversite öğrencisi katılmış olup; öğrenciler sosyodemografik özellikler, uyku parametreleri ve beslenme alışkanlıkları ile ilgili bir ön anket ve Sabahçı-Akşamcı Stabilite Ölçeği-Geliştirilmiş'i yanıtlamıştır. Ayrıca 24 saatlik geri hatırlama yöntemi ile öğrencilerin besin alımları değerlendirilmiştir. **Bulgular:** Sabah etkisi, ana ve ara öğün sayısı, enerji, protein, toplam yağ, doymuş yağ asidi ile tekli doymamış yağ asidi alımı ve yumurta ve yağlı tohum tüketimiyle pozitif ilişki; hafta sonu uykuya dalma süresi, hafta içi ve hafta sonu uyanma saati ile negatif ilişki göstermiştir. Farklılık ise genellikle sabah etkisine zıt yönde korelasyonlar göstermiştir. Akşamcılık, hafta içi ve hafta sonu uyanma saatleri ile pozitif ilişki, ana öğün sayısı ve yumurta tüketimi ile negatif ilişki göstermiştir. Sirkadiyen ritim bileşenleri sabah etkisi, akşamcılık ve günlük varyasyon genliği (farklılığının) ile öğrencilerin diyet kalitesi arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır. **Sonuç:** Sirkadiyen ritim bileşenleri sabah etkisi ve farklılık ile üniversite öğrencilerinin diyet alımları arasındaki ilişki daha güçlü bulunmuştur. Bu bulguların doğrulanması ve üniversite öğrencilerine kişiye özgü beslenme tavsiyelerinde bulunulmasına yardımcı olacak olası ilişkilerin hangi yönde olduğunun ortaya konması için daha fazla çalışmaya ihtiyaç duyulmaktadır.

Anahtar Kelimeler: Sabah etkisi; akşamcılık; farklılık; uyku; diyet kalitesi

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Three chronotypes are included in circadian typology: morning type (MT), neither type, and evening type (ET). While MT sleep early and get up early, and they show their best physical and mental performance in the early morning of the day, ET subjects sleep late and wake up late, and reach their highest potential throughout the late afternoon and evening.[1] Many studies on circadian typology or chronotype has used the Morningness-Eveningness Questionnaire (MEQ) in order to evaluate the relationship between chronotype and use of substances, dietary habits, nutritional intakes and eating behaviors.[2-7] Previous studies reported an increased frequency of breakfast skipping and higher intake of energy, carbohydrate and fat among ET undergraduate students.[6,8] Moreover, eveningness (EV) was associated with higher loss of control over eating, emotional eating, and tend to hunger in university students.[7] Contrary to individuals with circadian preference for evening hours, MT subjects displayed more healthy lifestyles including favorable dietary habits.[5] In a recent systematic review evaluating the role of chronotype in dietary intake, it was reported that late type individuals are more likely to exhibit unhealthy dietary habits, while early types are more likely to display healthy behaviors.[9] Chronotype begins to change during the developmental transition from adolescence to university life.[10] Also, transition from high school to university has been considered influential in changes in long-term eating habits and dietary patterns.[11] The results of the above studies have suggested that circadian rhythm differences may also be effective on the changing eating habits and eating patterns of university students.

The amplitude which refers to the range of diurnal fluctations in morningness-EV was suggested as an additional measure of circadian rthym.[12] Some people are more stable in their performance and mood, while others have strong changes during the day. Therefore, amplitude distinctness (DI) was measured in morningness-eveningness stability scale in addition to morning affect (MA) and EV. Previous studies used morningness-eveningness stability scales improved (MESSi) indicated that MA was associated with higher levels of life satisfaction, mindfulness, better sleep quality, and conscientiousness, while DI displayed negative associations with these variables.[13,14] Studies in the literature used MEQ in order to assess the relationship between chronotypes and dietary habits and nutritional intakes.[9,15]

According to the best of the author's knowledge, this is the first study evaluating eating habits, dietary intakes and diet quality of university students according to both their chronotypes and diurnal amplitudes. The current study aimed to investigate whether morning affect, EV and DI are related to eating habits, dietary intakes and diet quality of university students.

MATERIAL AND METHODS

STUDY PARTICIPANTS AND PRELIMINARY QUESTIONNAIRE

Six hundred and five healthy university students from Hacettepe University participated in this study between November 2022-January 2023. The sample size was found to be 507, with a 95% power and 0.05 margin of Type 1 error.[16] All participants gave written informed consent. Pregnancy, diagnosis of eating disorders and any type of chronic diseases like diabetes, cardiovascular diseases, and hypertension, and being a student of department of nutrition and dietetics were all ruled out for the study. The Hacettepe University Non-Interventional Clinical Research Ethics Board approved this study (date: November 1, 2022, no: 22/1100). The guiding principles of the Helsinki Declaration were applied in order to conduct the study.

The preliminary questionnaire is composed of 3 sections including sociodemographic characteristics (age, sex, marital status, smoking status etc.), sleep parameters and eating habits (number of meals and snacks).

THE MORNINGNESS-EVENINGNESS STABILITY SCALE IMPROVED

MESSi is developed by Randler et al. and adopted as a valid and reliable tool in Turkish to determine MA, EV and DI in Turkish students.[17,18] MESSi was composed of 15 items with 5 answer options. The Turkish form of the scale's Cronbach's alpha values for the MA, EV, and DI were found to be 0.84, 0.81, and

0.58, respectively. Higher scores show more MA, EV and DI.

DIETARY ASSESSMENT AND DIET QUALITY

The 24-hour dietary recall (a weekday) method was used in order to assess food and beverages consumption of the participants.[19] The students were asked to ensure as much information as possible regarding the food and drinks they ingested the day before the interview, including product names and home-cooked meal recipes. A photographic atlas of food portion sizes was used to estimate the portion sizes of the food consumed.[20] Food intake in grams was converted to daily energy consumption and nutrient intake by utilizing information from the food composition tables and a computer software "BEBIS."[21]

The Healthy Eating Index-2015 (HEI-2015) was used to assess dietary quality of participants.[22] HEI-2015 is scored 0 to 100 which was drived from the sum of 13 components. These 13 components consists of 9 adequacy components and 4 moderation components. Six adequacy components (total fruits, whole fruits, total vegetables, greens, beans, total protein foods, seafood, and plant proteins) are scored with 0-5 points and 3 of them (whole grains, dairy, fatty acids) are with 0-10 points. Four moderation components (sodium, refined grains, added sugars, and saturated fats) are scored with 0-10 points. The final HEI-2015 score is computed by summing the all components' points. The calculation is performed on the quantities of components in energy density per 1,000 kcal.[22] A higher HEI-2015 score indicates a higher quality of diet.

STATISTICAL ANALYSES

The statistical analyses were carried out using IBM SPSS Statistics (Version 23.0, Armonk, NY: IBM Corp.) Descriptive analyses were presented using tables of frequencies for ordinal variables, and means and standard deviations for normally distributed variables. Evaluation of the relationship between sleep duration, eating habits, dietary intakes, diet quality and MA, EV and DI of university students was performed by Pearson's correlation coefficients. Correlations were classified weak if r was less than 0.30, moderate if r was 0.30-0.70 and strong if r was greater than 0.70.

RESULTS

Table 1 depicts that participants comprised university students, with a mean age of 21.09 (±1.85) years and the majority was female (n=370; 61.2%). Self-reported mean sleep durations were 7.61±(1.11) hours. Participants took 21.25(±19.26) minutes fall asleep during weekdays and 23.93±(22.15) minutes during weekend. Regarding eating habits, mean number of main meals during a day was 2.47 (±0.54) and 38.2% of the participants skipped breakfast. The average scores of MA, EV and DI were indicated in Figure 1 and reported 16.03 (±3.86), 15.49 (±4.21) and 17.26 (±3.40), respectively.

TABLE 1: Sociodemographic characteristics, sleep parameters and eating habits of university students.

Variables	University students (n=605) Number (%)
Sex	
Male	235 (38.8)
Female	370 (61.2)
Age (years) (mean±SD)	21.09±1.85
Marital status	
Single	603 (99.7)
Married	2 (0.3)
Smoking status	
Yes	193 (31.9)
No	412 (68.1)
Sleep duration (hours) (mean±SD)	7.61±1.11
Time to fall asleep during weekdays (minutes) (mean±SD)	21.25±19.26
Time to fall asleep during weekends (minutes) (mean±SD)	23.93±22.15
Skipping meals during the day	
Yes	151 (25.0)
Sometimes	276 (45.6)
No	178 (29.4)
Number of main meals during a day (mean±SD)	2.47±0.54
Skipped meals	
No skipping	174 (28.8)
Breakfast	231 (38.2)
Lunch	177 (29.3)
Dinner	23 (3.8)
Number of snacks (mean±SD)	1.29±0.84
Total	605 (100)

SD: Stardard deviation.

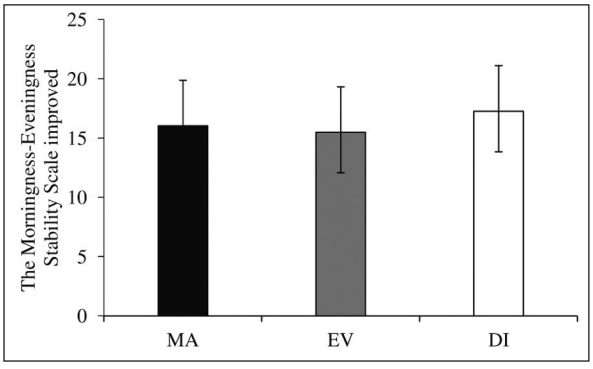

FIGURE 1: The average scores of morning affect (MA), eveningness (EV) and distinctness (DI) of university students.

Selected food groups, nutrient intakes and HEI-2015 scores of university students is indicated in Table 2. The HEI 2015 overall score was 51.70(±12.27). Correlations between sleep parameters, nutritional habits, dietary intakes, diet quality and MA, EV and DI of university students is depicted in Table 3. MA showed negative correlations with time to fall asleep during weekends (r=-0.088, p<0.05), wake up time on weekdays (r=-0.148, p<0.05) and weekends (r=-0.225, p<0.001). MA displayed positive correlations with number of main meals (r=0.142, p<0.001) and snacks (r=0.087, p<0.05), energy (r=0.106, p<0.05), protein (r=0.120, p<0.05), total fat (r=0.129, p<0.05), SFAs (r=0.143, p<0.001), MUFAs (r=0.169, p<0.001) intakes and consumption of egg (r=0.112, p<0.05) and nuts (r=0.159, p<0.001). EV exhibited positive correlations with wake up time on weekdays (r=0.197, p<0.05) and weekends (r=0.219, p<0.001), and a weak negative but statistically significant correlation with number of main meals (r=-0.124, p<0.05) and egg consumption (r=-0.085, p<0.05). The rest dietary intake correlations with EV were weak (r<0.1) and not statistically significant. DI exhibited weak positive correlations with time to fall asleep during weekdays (r=0.083, p<0.05) and weekends (r=0.089, p<0.05), and small negative correlations with fat (r=-0.096, p<0.05), protein (r=-0.096, p<0.05), MUFAs (r=-0.113, p<0.05), caffeine (r=-0.086, p<0.05) intakes and egg consumption (r=-0.107, p<0.05) and nuts (r=-0.113, p<0.001). All HEI-2015 scores correlations with EV or DI were very weak (r<0.1) and not statistically significant. MA displayed a weak positive correlation with total protein foods score (r=0.080, p<0.05) and a weak negative correlation with saturated fats score (r=-0.087, p<0.05). Also, consisted with previous research, MA negatively correlated with EV (r=-0.405, p<0.001) and DI (r=-0.315, p<0.001).

TABLE 2: Selected food groups, nutrient intakes and HEI-2015 scores of university students (n=605).

	Mean (SD)
Nutrients	
Caloric intake (kcal)	1768.36±591.02
Protein (g)	69.89±28.58
Carbohydrate (g)	191.61±75.35
Total fat (g)	78.20±32.03
SFAs (g)	26.67±11.99
MUFAs (g)	26.626±11.95
PUFAs (g)	18.48±10.78
Dietary fiber (g)	19.08±8.30
Caffeine (mg)	44.79±106.37
Food groups	
Milk and dairy products (g)	189.56±146.22
Meat	111.38±96.19
Fish	3.61±26.19
Egg	32.06±38.07
Processed meat products (g)	4.88±15.81
Vegetables (g)	260.16±200.24
Fruits (g)	90.78±129.73
Cereals (g)	214.88±113.24
Nuts (g)	6.40±19.38
Legumes (g)	20.76±30.85
Sweetened beverages g)	49.30±128.20
Salty snacks (g)	4.02±19.24
Sugary snacks (g)	17.75±35.41
HEI-2015 scores	
Overall scores	51.70±12.27
Component scores	
Total fruits	1.27±1.65
Whole fruits	1.82±2.13
Total vegetables	2.60±1.59
Greens and beans	2.14±2.00
Whole grains	3.11±4.16
Dairy	3.48±2.53
Total protein foods	4.27±1.29
Seafood and plant proteins	0.36±0.67
Fatty acids	6.11±3.3
Refined grains	7.01±3.45
Sodium	5.69±4.23
Added sugars	8.67±2.39
Saturated fats	5.15±3.41

SFAs: Saturated fatty acids; MUFAs: Monounsaturated fatty acids; PUFAs: Polyunsaturated fatty acids.

TABLE 3: Correlation coefficients between sleep parameters, eating habits, dietary intakes, diet quality and morning affect (MA), eveningness (EV) and distinctness (DI) of university students (n=605).

	MA	EV	DI
Morning effect (MA)	-	-0.405**	-0.315**
Eveningness (EV)	-0.405**	-	-0.052
Sleep duration	-0.076	-0.007	0.074
Time to fall asleep during weekdays	-0.079	0.032	0.083*
Time to fall asleep during weekends	-0.088*	0.047	0.089*
Wake up time on weekdays	-0.148*	0.197*	0.024
Wake up time on weekends	-0.225**	0.219**	0.038
Number of main meals	0.142**	-0.124*	-0.006
Number of snacks	0.087*	-0.055	0.004
Caloric intake (kcal)	0.106*	-0.008	-0.068
Protein (g)	0.120*	-0.002	-0.096*
Carbohydrate (g)	0.039	-0.025	-0.006
Total fat (g)	0.129*	0.007	-0.096*
SFAs (g)	0.143**	-0.053	-0.069
MUFAs (g)	0.169**	-0.019	-0.113*
PUFAs (g)	0.027	0.075	-0.059
Caffeine (mg)	-0.050	0.010	-0.086*
Milk and dairy products (g)	0.056	-0.060	-0.077
Meat	0.078	0.042	0.007
Fish	-0.031	-0.053	0.001
Egg	0.142**	-0.85*	-0.107*
Processed meat products (g)	-0.061	-0.010	0.038
Vegetables (g)	0.057	-0.057	0.028
Fruits (g)	0.066	-0.055	0.021
Cereals (g)	0.058	-0.018	-0.026
Nuts (g)	0.159**	-0.005	-0.113*
Legumes (g)	0.041	-0.037	-0.029
Sweetened beverages g)	-0.012	0.019	0.068
Salty snacks (g)	-0.022	0.059	-0.025
Sugary snacks (g)	-0.013	-0.009	0.016
HEI-2015 scores			
Component scores			
Total fruits	0.039	-0.044	0.042
Whole fruits	0.038	-0.050	0.030
Total vegetables	-0.023	-0.051	0.037
Greens and beans	-0.056	-0.011	0.044
Whole grains	-0.026	-0.029	-0.008
Dairy	0.032	-0.065	-0.043
Total protein foods	0.080*	-0.019	-0.045
Seafood and plant proteins	0.011	-0.012	-0.016
Fatty acids	-0.069	0.073	-0.050
Refined grains	-0.002	-0.038	-0.029
Sodium	-0.063	0.048	0.002
Added sugars	0.034	0.011	-0.003
Saturated fats	-0.087*	0.047	-0.002
Overall scores	-0.052	-0.008	-0.016

*p<0.05; **p<0.001; SFAs: Saturated fatty acids; MUFAs: Monounsaturated fatty acids; PUFAs: Polyunsaturated fatty acids.

DISCUSSION

In the current study, whether morningness-EV is associated with sleep parameters, eating habits, dietary intakes and diet quality was investigated. Recent research using MESSi has focused on the relationship between morningness-EV and negative emotionality.[13,14]

Average scores of MA, EV and DI in this study were found similar with the previous research results.[13,23] Also, MA displayed negative associations with EV and DI which concurred with the findings of previous studies.[14,18] MA which is considered alertness soon after waking was positively correlated with favourable personality traits including conscientiousness and negatively associated with depression, anxiety, stress and unfavourable personality traits such as neuroticism.[13,14] DI which is defined as the amplitude of diurnal fluctuation in mood, motivation, and cognitive functioning showed opposite associations with these varibles.[13,14] Also, recent findings highlighted that both MA and stronger amplitude DI rather than EV may become more related to negative emotions, such as depression, anxiety and stress, personality traits and wellbeing.[13,14,23,24] In the current study, while EV showed negative weak associations with sleep parameters, number of main meals and egg consumption, MA and DI exhibited more associations with the variables related to sleep parameters, eating habits and dietary intakes which may be considered both MA and DI rather than EV are more related to sleep parameters, eating habits and dietary intakes of university students.

Poor sleep quality and sleep problems was negatively associated with MA, and positively associated with DI.[13,14] Difficulty in falling asleep is one of the common sleep problems among university students and in the present study time to fall asleep displayed negative association with morningness and positive association with DI.[25] Consistent with previous studies, morningness showed negative and EV showed positive associations with wake up times on weekdays and weekends.[26,27]

Studies assessing eating habits and dietary intakes of the individuals according to chronotypes reported conflicting results.[5,28-30] In a study of conducted with a sample of Iranian adults, it was indicated that energy intake, dietary intake and eating habits had no relationship with chronotype.[28] Similarly, Yang and Tucker showed that no significant differences in energy and macronutrient intakes, consumption of healthy snack frequency and sugar-sweetened beverages or diet quality among chronotypes were indicated.[29] However, another studies found that chronotype score was negatively associated with consumption of sweets and vegetables.[5,27,31] Also, better diet quality among morning individuals and poor diet quality among evening types were reported.[15,27]

In the current study, MA showed positive associations with energy and macronutrient intakes [protein, total fat, saturated fatty acids (SFAs) and monounsaturated fatty acids (MUFAs)] and consumption of egg and nuts. Hovewer, no statistically significant associations were determined between MA and neither consumption of fruits and vegetables, sweetened beverages or unhealthy snacks nor diet quality. One explanation for positive associations between MA and consumption of egg and nuts might become positive associations between MA and number of main meals and snacks. The prevelance of skipping meals, especially breakfast, was lower among the MT subjects when compared to ET subjects.[6] Due to the fact that circadian rhythms of evening types are delayed, they mostly skip breakfast. Lack of biological clock signaling regarding the time that breakfast should be consumed, ET people do not consume this meal.[32] Another possible reason for breakfast skipping is that waking up late to start their daily activities as shown in the current study. Skipping breakfast may result in low egg consumption among university students as Turkish people consume eggs mostly at breakfast.[33] The positive association between consumption of nuts and MA in the present study may show that MT people may prefer healthy snacks such as nuts. Egg is one of the most important sources of animal protein and fat. One third of its fat consists of SFAs, 10% PUFAs and rest MUFAs.[34] Nuts include plant derived protein and fat and its fatty acid composition comprises of 4-16% SFAs and 50% unsaturated fatty acids.[35] Therefore, positive associations between MA and egg and nuts

consumption may be an explanatory factor for the positive associations between MA and macronutrient intakes including protein, fat, SFAs and MUFAs in this study.

The findings for stronger amplitude DI has reported that this particular aspect of circadian functioning is related to poorer wellbeing, poor sleep quality and negative emotionality including depression, anxiety and stress.[13,14,24] In the current study, time to fall a sleep which is related to poor sleep quality was negatively correlated with DI. Other variables including eating habits and dietary intakes showed negative associations with DI which may be related to have large diurnal variation (more DI) as mood and the effectiveness of cognitive functioning of these people exhibits large variation throughout the day.[12] According to the best of the author's knowledge, there has been no study in the literature examining the association between DI and dietary intakes, so more studies should investigate this relationship. Also, the findings of above studies indicated that components of the circadian rhytms including MA and DI were mostly associated with emotional aspects of individuals. Therefore, if the eating styles like intuitive eating, emotional eating and loss of control over eating is included in the assessment, the associations may get stronger and a clear relationship between nutrition and circadian rhythm components may be established.

The current study's cross-sectional design is one of the its limitations. Another limitation of the study is that food intake was analyzed by only one weekday of food recall. Taking at least one weekend food consumption record would contribute more powerful food intake analysis. Due to the fact that consumption of food and beverages intake on weekends could differ from weekdays, it is very crucial to investigate the associations between circadian rhythm components and nutrition on weekends, too. The study sample was limited with university students from Hacettepe University, so the results can not be generalised to the general population.

CONCLUSION

In conclusion, the present study reported that MA and DI are associated with sleep parameters, eating habits and dietary intakes of university students. EV showed associations with limited number of these variables. Finally, no association was established between circadian rhythm components of MA, EV and DI, and diet quality of university students. More studies should be conducted examining the possible relationship between circadian rhythm components and nutrition and eating behaviors to develop personalised nutrition advice to university students.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

This study is entirely author's own work and no other author contribution.

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