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RESEARCH ARTICLE– versión *post-print*

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Evaluation of the relationship between chronotype, adherence to the mediterranean diet, and cardiometabolic health in adults

Evaluación de la relación entre cronotipo, adherencia a la dieta mediterránea y salud cardiometabólica en adultos

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ABSTRACT

Introduction: This study was planned to evaluate the relationship between chronotype, adherence to a Mediterranean diet, and cardiometabolic health in adults.

Methodology: Descriptive, cross-sectional, and cross-analytical study. A total of 205 adults from Turkey, who were 18–65 years old, completed an online survey between May and June 2021. Participants filled out a questionnaire that contained the general information form, anthropometric measurements, cardiometabolic health status, chronotype, and adherence to the Mediterranean Diet.

Results: 69 (33.7%) men and 136 (66.3%) women participated in the study. According to the BMI classification, 38.5% were overweight, and 14.6% were people with obesity. 9.3% of the participants stated that they had cardiovascular disease and 8.3% stated that they had type 2 diabetes. The mean chronotype scale score of the participants was calculated as 51.8 (17.3), 42 (20.5%) morningness type, 139 (67.8 %) intermediate type, and 24 (11.7%) eveningness type. The mean PREDIMED (Prevención con Dieta Mediterránea) score of the adults participating in the study was 5.7 (1.7), and it was determined that 46.3% had low adherence to the Mediterranean diet, 51.7% had medium and 2.0% had high. A significant difference was found between the participants' age, BMI classification, occupation according to chronotype, and waist circumference according to Mediterranean diet compliance ($p < 0.05$). A negative correlation was found between waist circumference and PREDIMED score ($r = -0.160$, $p < 0.01$).

Conclusions: It was observed that the majority of the adults were in intermediate chronotype and their adherence to the Mediterranean diet was low. No relationship was found between chronotype, adherence to the Mediterranean diet, and cardiometabolic health.

Keywords: Chronotype; Diet, Mediterranean; Cardiovascular diseases; Diabetes Mellitus, Type 2; Obesity.

RESUMEN

Introducción: Este estudio fue planeado para evaluar la relación entre el cronotipo, la adherencia a una dieta mediterránea y la salud cardiometabólica en adultos.

Metodología: Estudio descriptivo, transversal y transversal analítico. Un total de 205 adultos de Turquía, que tenían entre 18 y 65 años, completaron una encuesta en línea entre mayo y junio de 2021. Los participantes cumplimentaron un cuestionario que contenía el formulario de información general, medidas antropométricas, estado de salud cardiometabólico, cronotipo y adherencia a la Dieta Mediterránea.

Resultados: Participaron del estudio 69 (33.7%) hombres y 136 (66.3%) mujeres. Según la clasificación del IMC, el 38.5% tenían sobrepeso y el 14.6% eran personas con obesidad. El 9.3% de los participantes manifestó tener enfermedad cardiovascular y el 8.3% manifestó tener diabetes tipo 2. La puntuación media de la escala de cronotipo de los participantes se calculó como 51.8 (17.3), 42 (20.5 %) de tipo matutino, 139 (67.8 %) de tipo intermedio y 24 (11.7 %) de tipo vespertino. La puntuación media de PREDIMED (Prevención con Dieta Mediterránea) de los adultos participantes en el estudio fue de 5.7 (1.7), y se determinó que el 46.3% tenía baja adherencia a la dieta mediterránea, el 51.7% media y el 2.0% alta. Se encontró una diferencia significativa entre la edad de los participantes, la clasificación del IMC y la ocupación según el cronotipo y la circunferencia de la cintura según el cumplimiento de la dieta mediterránea ($p < 0,05$). Se encontró una correlación negativa entre la circunferencia de la cintura y la puntuación PREDIMED ($r = -0,160$, $p < 0,01$).

Conclusiones: Se observó que la mayoría de los adultos se encontraban en cronotipo intermedio y su adherencia a la dieta mediterránea era baja. No se encontró relación entre el cronotipo, la adherencia a la dieta mediterránea y la salud cardiometabólica.

Palabras clave: Cronotipo; Dieta Mediterránea; Enfermedades cardiovasculares; Diabetes mellitus tipo 2; Obesidad.

KEY MESSAGES

- It was determined that most of the adults were in the intermediate chronotype and their adherence to the Mediterranean diet was low.
- Most of the people with obesity are of the evening type, high PREDIMED score was associated with low values of BMI and waist circumference.
- Adults should determine their chronotype status and should be advised to increase their adherence to the Mediterranean diet.
- In the treatment of obesity, chronotype and adherence to the Mediterranean diet should be evaluated.

INTRODUCTION

In general, the secretion of the thyroid-stimulating hormone is in a regular rhythm and rises before sleep, reaches its highest level while asleep, decreases towards the morning, and reaches its lowest level on noonday. This situation is called circadian rhythm[1]. Physiological and behavioral processes, including body temperature, hormones such as cortisol, and melatonin, or factors such as cognition and mood, show a circadian rhythm[2]. The concept of chronotype, which is related to chronobiology and examines rhythmic elements in biological events within the framework of individual characteristics, reflects the circadian phases of individuals. These phases show what time of day the person's physical functions, hormone levels, body temperature, cognitive abilities, eating, and sleeping patterns are active[3]. While adolescence and young adulthood are associated with evening-type preference, childhood and adulthood are stated as the period when the tendency to be morning-type increases[4].

There are three categories based on circadian behavioral phenotype variants as the morning, evening, and intermediate chronotype[5]. Morning chronotypes prefer to get up early and do their activities early, while evening chronotypes get up late and do their activities mostly in the afternoon and evening. Intermediate-type chronotypes are the type between morning and evening chronotypes. Evening chronotypes have more health problems such as psychological disorders, gastrointestinal diseases, and higher mortality rates compared to morning chronotypes[6], and metabolic diseases such as type 2 diabetes and metabolic syndrome are observed more frequently[7]. Sleep disorders are more common in evening chronotypes because they go to bed late and wake up

earlier than their biological mornings due to their social needs[8]. Among those with the late chronotype, sleep deprivation may be observed as a result of higher consumption of caffeinated beverages, alcohol, and sweets, and intense work schedules that start early in the day[9]. Most of the time, sleep disorders lead to increased consumption of unhealthy foods and therefore an increased susceptibility to obesity[10,11]. It is also suggested that the consequences of circadian misalignments, such as eating at the wrong time of day, skipping breakfast, and eating at night, are also associated with obesity and metabolic syndrome[12]. In a study, it was determined that evening chronotypes consume sugary and alcoholic beverages more in addition to unhealthy foods such as chocolate and sugary drinks and less healthy foods such as vegetables, fruits, and fish compared to morning chronotypes[13]. In different studies, it has been determined that evening chronotypes are associated with an unhealthy lifestyle and low adherence to the Mediterranean diet[14,15]. The Mediterranean diet is based on high consumption of vegetables and fruits, cereals and whole grains, pulses and nuts, moderate to high intake of fish and seafood, olive oil as the main (added) fat, and low to moderate intake of a dairy product. A Mediterranean diet can counterbalance the detrimental effects of central obesity associated with chronic diseases (diabetes mellitus, cardiovascular diseases, etc.) In this context, the Mediterranean diet is recognized as healthy eating that which contributes to better health and quality of life[16,17].

In recent years, the role of individual chronotype in the development of metabolic diseases has been intensely debated. Several studies have shown that chronotype is associated with cardiometabolic risk factors[10,11]. It has been reported that demonstrating the biological rhythms of diseased and healthy periods in humans in this way may contribute to medical developments in terms of diagnosis and treatment processes of the disease[18].

In this study, the aim was to evaluate the relationship between chronotype, adherence to a Mediterranean diet, and cardiometabolic health in adults. We hypothesized that adults with a greater eveningness chronotype will have less adherence to the Mediterranean diet and higher cardiometabolic risk factors.

METHODS

Study design and participants

This is a descriptive, cross-sectional, and cross-analytical study carried out on 205 adults who were 18–65 years old. Adult individuals were reached who had Internet access and volunteered to participate in the study. Society in terms of representing the universe, the number of samples that will represent a normal distribution in the data on the subject is 300 (three hundred) -400 (four hundred); it is ideal to be around 100, but it is a useful practice not to fall below 100 (hundred). The online survey was made available through e-mail or social media (WhatsApp) and randomly dispersed to as many people as possible between May 11 and July 20, 2021.

The study protocol and the free-informed consent procedures were carried out following the last revised Helsinki Declaration and were approved by the Human Research Ethics Committee of the Erzincan Binali Yıldırım University of Turkey and 05/36 numbered 30.04.2021 dated.

Collection of data

General Information and Anthropometric Measurements

General information form which has 8 items. This form, which is applied to the sample group, includes questions that evaluate sociodemographic characteristics (age, gender, educational status, and job) and other lifestyle factors (daily smoking and alcohol consumption (regardless of the amount, the participant was asked whether she regularly smoked and used alcohol every day, and was examined in two categories as "yes" and "no".) and cardiometabolic health status (the presence of Type 2 DM or CVD (myocardial infarction, stroke, hypertension).

Anthropometric measurements were based on the statements of the participants. In this evaluation, current body mass (kg), height (cm), and waist circumference (cm) measurements were asked. Body mass index (BMI) was calculated according to the World Health Organization (WHO) classification by calculating kg/m^2 with the formula of body weight/height (m^2). BMI is categorized as underweight (<18.5 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2) and obesity class I (30.0–34.9 kg/m^2); obesity class II (35.0–39.9 kg/m^2) and obesity class III (≥40 kg/m^2)[19].

Assessment of Chronotype

The Horne and Ostberg Morningness-Eveningness Questionnaire (MEQ) was used for the assessment of chronotype[5]. The validity and reliability of the scale for Turkey were conducted by Punduk et al[20]. MEQ is the most commonly used scale to determine chronotypes. This 19-item self-report scale is used for screening purposes and gives scores ranging from 16 to 86, and the final score allows for determining which chronotype the participant belongs to. According to the values obtained after the calculations in the evaluation of the scale, 59-86 determine the morning type, 42-58 intermediate type, and 16-41 evening type groups.

Adherence to the Mediterranean Diet

Adherence to the Mediterranean diet was assessed using the previously validated 14-item PREDIMED (Prevención con Dieta Mediterránea) questionnaire[21]. The validity and reliability of the Turkish version of the scale were performed by Pehlivanoglu et al[22]. This scale includes a total of 14 items. One point is given if the condition of an item is met according to adherence to the Mediterranean diet, and 0 points are given if it is not met. The highest score is 14 points, with higher scores indicating better adherence to the Mediterranean diet. Adherence to the Mediterranean diet scores is divided into three groups according to the level of adherence: ≤5 points are low, 6-9 points are moderate, and ≥10 points are high.

Statistical analyses

The data distribution was evaluated by Kolmogorov-Smirnov test. Descriptive statistics such as median, minimum and maximum, and percentage were used in the evaluation of the data. Additionally, statistical analysis methods of the Kruskal-Wallis test, Pearson Chi-square test, Fisher-Freeman-Halton Exact test, and Pearson Correlation Analysis were employed.

Multivariate logistic regression analyses were carried out to evaluate associations between chronotype categories and adherence to the Mediterranean diet after adjustment for age, gender, BMI, waist circumference, cardiometabolic health status (model 1), and PREDIMED score (model 2). Multivariate logistic regression analyses were carried out to evaluate associations between chronotype or the presence of T2DM and CVD after adjustment for age, gender, BMI (model 1), and

chronotype score or PREDIMED score (model 2). All statistical analyses were performed using the IBM 22.0 software. The significance level was determined as p<0.05 for all analyses.

RESULTS

A total of 205 adults, 69 (33.7%) men, and 136 (66.3%) women, with a median age of 38.0 (17.0-68.0) years, participated in the study. The median BMI of the adults was calculated as 25.4 (16.5-41.7) kg/m2, according to the BMI classification, 4.4% were underweight, 42.4% were normal, 38.5% were overweight, and 14.6% were obese. The median waist circumference of the participants was 83.0 (69.0-150.0) cm. 20.5% of the participants stated that they smoked and 13.2% of them consumed alcohol. 57.6% of the adults are university graduates and 42.0% were civil servants. 9.3% of the participants stated that they had cardiovascular disease and 8.3% of them stated that they had type 2 diabetes. The median chronotype scale score of the participants was calculated as 52.0 (27-67), 42 (20.5%) morningness type, 139 (67.8 %) intermediate type, and 24 (11.7%) eveningness type. The median PREDIMED score of the adults participating in the study was 6.0 (2-10), and it was determined that 46.3% had low adherence to the Mediterranean diet, 51.7% had medium and 2.0% had high.

Adult's demographic characteristics, anthropometric measurements, disease status according to chronotype, and adherence to the Mediterranean diet were shown in Table 1. A significant difference was found between the participants' age, BMI classification, and occupation according to chronotype (p<0.05). A significant relationship was found between the waist circumference of the participants according to adherence to the Mediterranean diet (p<0.05).

Table 1. Adult's demographic characteristics, anthropometric measurements, disease status according to chronotype, and adherence to the Mediterranean diet

	Chronotype				**Adherence to Mediterranean Diet**			
	Morningness-type (n=42)	**Intermediate-type (n=139)**	**Eveningness-type (n=24)**	**p**	**Low (n=95)**	**Medium (n=106)**	**High (n=4)**	**p**
Age (year), median (Min-Max)	44.0 (19.0-65.0)	37.0 (18.0-68.0)	35.0 (17.0-65.0)	0.014**	39.0 (17.0-65.0)	37.5 (17.0-68.0)	31.0 (24.0-55.0)	0.720
BMI (kg/m^2), median (Min-Max)	26.1 (16.8-39.3)	25.5 (16.5-41.7)	22.6(18.5-35.3)	0.129	25.8 (16.7-41.7)	25.1 (16.5-39.5)	25.1 (21.2-26.1)	0.464

Waist circumference (cm), median (Min-Max)	87.5 (80.0-114.0)	83.0 (76.0-150.0)	76.5 (60.0-120.0)	0.602	85.0 (35.0-150.0)	80.0(75.0-120.0)	93.5(68.0-105.0)	0.036**
PREDIMED score, median (Min-Max)	6.0 (3.0-9.0)	6.0(2.0-10.0)	6.0 (3.0-10.0)	0.625	-	-	-	-
Chronotype score, median (Min-Max)	-	-	-	-	52.0(27-65)	52.5 (34-67)	49 (45-56)	0.698
Gender, n (%)								
Male	19 (45.2)	44 (31.7)	6 (25.0)	0.167	36 (37.9)	30 (28.3)	3 (75.0)	0.064
Female	23 (54.8)	95 (68.3)	18 (75.0)		59 (62.1)	76 (71.7)	1 (25.0)	
BMI classification, n (%)								
Slim	7 (16.7)	2 (5.1)	-		3 (3.2)	6 (5.7)	-	
Normal body weight	12 (28.6)	72 (51.7)	3 (12.5)		38 (40.0)	47 (44.3)	2 (50.0)	
Overweight	18 (42.9)	56 (36.8)	5 (20.8)	0.033*	33 (41.8)	44 (41.5)	2 (50.0)	0.157
Obesity	5 (11.9)	9 (6.4)	16 (66.7)		21 (22.0)	9 (8.5)	-	
Smoking, n (%)								
Yes	7 (16.7)	27 (19.4)	8 (33.3)		22 (3.2)	20 (18.9)	-	
No	35 (83.3)	112 (80.6)	16 (66.7)	0.234	73 (76.8)	86 (81.1)	4 (100.0)	0.583
Alcohol use status, n (%)								
Yes	6 (14.3)	17 (12.2)	4 (16.7)		14 (14.7)	13 (12.3)	-	
No	36 (85.7)	122 (87.8)	20 (83.3)	0.815	81 (85.3)	93 (87.7)	4 (100.0)	0.819
Educational status, n (%)								
Primary school	2 (4.8)	3 (2.2)	1 (4.2)	0.833	5 (5.3)	1 (0.9)	-	0.385
Middle School	1 (2.4)	6 (4.3)	1 (4.2)		2 (2.1)	6 (5.7)	-	
High school	5 (11.9)	29 (20.9)	4 (16.7)		17 (17.9)	21 (19.8)	-	
University	25 (59.5)	78 (56.1)	15 (62.5)		58 (61.1)	57 (53.8)	3 (75.0)	
Postgraduate (Master/PhD)	9 (21.4)	23 (16.5)	3 (12.5)		13 (13.6)	21 (19.8)	1 (25.0)	
Job, n (%)								
Officer	19 (45.2)	57 (41.0)	10 (41.7)	0.021*	36 (37.9)	46 (43.4)	4 (100.0)	0.872
Insured worker	1 (2.4)	12 (8.6)	-		6 (6.3)	7 (6.6)	-	
Self-employment	3 (7.1)	4 (2.9)	-		5 (5.3)	2 (1.9)	-	
Retired	5 (11.9)	4 (2.9)	1 (4.2)		4 (4.2)	6 (5.7)	-	

Housewife	8 (19.0)	31 (22.3)	4 (16.7)		21 (22.1)	22 (20.8)	-	
Unemployed	1 (2.4)	2 (1.4)	4 (16.7)		3 (3.2)	4 (3.8)	-	
Student	5 (11.9)	29 (20.9)	5 (20.8)		20 (21.1)	19 (17.9)	-	
Cardiovascular disease status, n (%)								
Yes	6 (14.3)	11 (7.9)	2 (8.3)	0.452	11 (11.6)	7 (6.6)	1 (25.0)	0.168
No	36 (85.7)	128 (92.1)	22 (91.7)		84 (88.4)	99 (93.4)	3 (75.0)	
Type 2 diabetes status, n (%)								
Yes	5 (11.9)	10 (7.2)	2 (8.3)	0.583	9 (9.5)	7 (6.6)	1 (25.0)	0.335
No	37 (88.1)	129 (92.8)	22 (91.7)		86 (90.5)	99 (93.4)	3 (75.0)	

*Fisher-Freeman-Halton Exact test, **Kruskal-Wallis test

The association between chronotype categories and adherence to the Mediterranean diet is reported in Table 2. No significant difference was found between chronotype categories and adherence to the Mediterranean diet.

Table 2. Associations between chronotype categories and adherence to the Mediterranean

	Odds ratio	**95 % CI**	**p**
Morning chronotype vs intermediate chronotype			
Model 1	0.668	0.181-3.573	0.652
Model 2	0.988	0.949-1.029	0.553
Morning chronotype vs evening chronotype			
Model 1	0.982	0.852-1.022	0.372
Model 2	0.988	0.956-1.021	0.475

Logistic regression analysis to evaluate the associations between chronotype and adherence to the Mediterranean diet after adjustment for age, gender, BMI, waist circumference, cardiometabolic

health status (model 1), and PREDIMED score (model 2).

The association between chronotype and the presence of T2DM and CVD is reported in Table 3. In both model 1 and model 2, no significant difference was found between chronotype and the presence of T2DM and CVD.

Table 3. Association of chronotype categories with T2DM and CVD

	p	OR	95%CI
Model 1 (without PREDIMED as a covariate)			
Morning chronotype vs intermediate chronotype			
T2DM	0.972	1.023	0.284-3.688
CVD	0.619	1.618	0.243-4.793
Morning chronotype vs evening chronotype			
T2DM	0.516	1.901	0.273-3.213
CVD	0.927	0.946	0.288-3.110
Intermediate chronotype vs evening chronotype			
T2DM	0.485	0.538	0.169-3.063
CVD	0.546	0.584	0.102-3.348
Model 2 (with PREDIMED as a covariate)			
Morning chronotype vs intermediate chronotype			
T2DM	0.963	1.031	0.284-3.743
CVD	0.925	0.944	0.287-3.102
Morning chronotype vs evening chronotype			
T2DM	0.519	0.529	0.176-3.671
CVD	0.598	1.669	0.248-11.214
Intermediate chronotype vs evening chronotype			

T2DM	0.492	0.545	0.197-3.080
CVD	0.525	0.566	0.180-3.276

Logistic regression analysis to evaluate the associations between chronotype and the presence of type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) after considering age, gender, and BMI as covariates (model 1) or after considering age, gender, BMI, and PREDIMED score as covariates (model 2).

DISCUSSION

Adults experience sleep disorders depending on their chronotype types, malnutrition behaviors such as irregular meals, skipping breakfast, eating at night, and consuming more unhealthy foods cause an increase in the risk of obesity and metabolic syndrome[10–12,23]. We evaluated the relationship between chronotype, adherence to a Mediterranean diet, and cardiometabolic health in adults in this study. It was determined that the majority of the adults were in the intermediate chronotype and their adherence to the Mediterranean diet was low.

In this study, it was determined that 20.5% of the participants were close to the morning type, 69.1% were close to the intermediate type and 11.7% were close to the evening type. When the studies on adults were examined, it was determined that the adults were intermediate type in most of the study results[6,7,24,25] and the results of this study were similar to other studies.

Culnan et al.[26] stated that among 137 university students, eveningness types had a higher BMI compared to morningness/intermediate types, and there was no relationship between chronotype and anthropometric variables (BMI and WC). According to Mota et al.[24] reported that there was no relationship between chronotype scores and neither BMI (coefficient = -0.01, p = 0.98) nor WC (coefficient = 0.09, p = 0.41).

Özkan et al.[27] reported that chronotype types showed a significant relationship with age and smoking, but there was no significant relationship with BMI, waist circumference, gender, education level, and alcohol use. Maukonen et al.[28] found in the results of their study that morningness type participants tended to have higher BMI averages than eveningness type and intermediate type participants. Both in our study and this study, the average age of eveningness type adults is lower than in other chronotypes.

In this study, a positive correlation was found between the participants' age, BMI classification, and occupation according to chronotype ($p < 0.05$). Considering that, it is inevitable to observe an increase in weight status with increasing age, the reason why eveningness type participants in these studies have lower BMI than other chronotypes could be explained. The significant relationship between chronotype and occupations might be related to the high number of morningness-type civil servants, but the high number of eveningness-type students.

Yu et al.[7] emphasized that eveningness chronotype was independently associated with diabetes, metabolic syndrome, and sarcopenia on a participant basis, and the results supported the importance of circadian rhythm in metabolic regulation. Makarem et al.6 shared that there was no significant relationship between MEQ scores and individual clinical cardiometabolic risk factors but showed significant relationships with health behaviors such as sleep and sedentary behavior. Muscogiuri et al.[29] reported that 12.8% of middle-aged participants were in the eveningness chronotype group and that those in this chronotype were associated with a significantly higher risk of T2DM and higher CVD than participants in the morningness and intermediate chronotype. In this study, no relationship was found between chronotype and cardiometabolic health.

Zerón-Rugerio et al.[30] found the chronotype rates of individuals as 20.6% for the eveningness type, 62.4% for the intermediate type, and 17.0% for the morningness type, and according to KIDMED, 4.9% of them showed poor, 50.7% moderate, and 44.4% good compliance. Mazri et al.13 reported that it is associated with unhealthy eating habits mostly related to obesity in eveningness types. Muscogiuri et al.31 found the mean PREDIMED score to be 7.8 (2.2) in their study with 172 participants. 21 (12.2%) participants had low, 110 (64%) average, 41 (23.8%) high MD adherence results; eveningness chronotype is associated with an unhealthy lifestyle and low adherence to MD.

In this study, according to MEDAS, 46.3% of the adults had low adherence to the Mediterranean diet, 51.7% had medium and 2.0% had high, the rate of obesity in the evening type was significantly higher than the other chronotypes, however, similar to the Zerón-Rugerio et al.[30] study, it was determined that there was no correlation between adherence to the Mediterranean diet and chronotype. In line with the results of the studies, it is important to evaluate the chronotype in the management of obesity and the development of nutrition strategies.

De Amicis et al.[25] found that study results showed no difference in WC between chronotypes, however, Mediterranean diet adherence was significantly lower in E-Types compared to M-Types and WC decreased as the Mediterranean diet adherence score increased. In this study, it was observed that the measurement of waist circumference was not related to chronotype, and as the score for compliance with the Mediterranean diet increased, the waist circumference and BMI values decreased.

Almoosawi et al.[32] shared that scientific evidence provides increasing insight into the relationship between chronotype, diet, and cardiometabolic health. In a study investigating the relationship between chronotype, the presence of T2DM and CVD, and adherence to a Mediterranean diet in adults, evening chronotype was found to have a high risk of being associated with T2DM and CVD29. According to this study's results, no relationship was found between chronotype, adherence to the Mediterranean diet, and cardiometabolic health.

The strengths of this study included a random sample and a population-based approach. Furthermore, chronotype and adherence to the Mediterranean diet were assessed using a validated method.

However, this study has several limitations. First, it was a cross-sectional study, making it difficult to find the causality. Second, it included a small sample size (N = 205). Third, anthropometric measurements were based only on self-reported data. In this study socioeconomic level, and sleep quality were not recorded. In addition, the study population was unbalanced regarding gender and age, although we minimized this bias by adjusting the statistical analysis for these potential confounding factors.

CONCLUSIONS

It was observed that the chronotypes of the adults were intermediate type and their adherence to the Mediterranean diet was low. The number of people with obesity in the eveningness type is higher. As the PREDIMED score increases, the measurement values of BMI and waist circumference decrease. No relationship was found between chronotype, adherence to the Mediterranean diet, and cardiometabolic health. The current results should be investigated further, it will be important to evaluate the chronotype and adherence to the Mediterranean diet in the clinical dimension of the relationship between T2DM and CVD.

AUTHORS' CONTRIBUTIONS

SKY and FY; supervision article administration and resources. SKY and FY; methodology and writing-original draft preparation. SKY and FY; data analysis. SKY and FY; editing, All authors have read and agreed to the published version of the manuscript.

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CONFLICTS OF INTEREST

All authors have no conflicts of interest.

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