DOI: 10.4274/gulhane.galenos.2023.57070
Gulhane Med J 2024;66:86-93

Associations between circadian preference, social jetlag, and diabetes mellitus risk in nurses working shifts

Metin Mercan[1], Melike Mercan Başpınar[2], Yıldız Tosun[3]

[1]University of Health Sciences Türkiye, Bakırköy Dr. Sadi Konuk Training and Research Hospital, Clinic of Neurology, İstanbul, Türkiye

[2]University of Health Sciences Türkiye, Gaziosmanpaşa Training and Research Hospital, Clinic of Family Medicine, İstanbul, Türkiye

[3]University of Health Sciences Türkiye, Taksim Training and Research Hospital, Division of Education, İstanbul, Türkiye

Date submitted:
12.08.2023
Date accepted:
12.12.2023
Online publication date:
15.06.2024

Corresponding Author:
Melike Mercan Başpınar, M.D.,
University of Health Sciences Türkiye, Gaziosmanpaşa Training and Research Hospital, Clinic of Family Medicine, İstanbul, Türkiye
+90 212 945 30 00
drmelikemercan@gmail.com

ORCID:
orcid.org/0000-0003-3183-3438

Keywords: Circadian preference, diabetes, morningness-eveningness, sleep, social jetlag

ABSTRACT

Aims: This study uncovered the links between circadian preferences, social jet lag, and diabetes mellitus (DM) risk screening results of nurses working shifts.

Methods: In this cross-sectional study design, sociodemographic data, the American Diabetes Association (ADA) Diabetes Risk Test, Morningness-Eveningness Stability Scale Improved (MESSi), sleep awake and bedtimes, and shift count were collected via survey. Participants were split into DM risk-positive and negative groups to compare them for MESSi scores, circadian preference and social jetlag.

Results: Short sleep keepers were 61.8% of all 212 nurses aged 32.25±6.99 years. Abnormal social jetlag was detected in 18.9% of the study population. The group that experienced abnormal social jetlag exhibited a significantly lower morning affect and a higher eveningness (EV) compared with the normal jetlag group (p=0.003 and p=0.004, respectively). DM risk was present in 6.6% of all. A higher risk of DM was observed in individuals with older age, longer job experience, higher body mass index (BMI), male gender, and lower EV score (p<0.001, p<0.001, p<0.001, p=0.006 and p=0.042, respectively). Distinctness scores were positively correlated with DM risk scores (r=0.168; p=0.014), whereas they inversely correlated with night shift count (r=-0.149; p=0.022). Higher values of BMI (odds ratio=1.255; 95% confidence interval=1.036-1.520; p=0.020) and male sex (odds ratio=7.350; 95% confidence interval=1.265-42,161; p=0.026) were associated with increased risk for DM.

Conclusions: This study reports that circadian preference, but not social jetlag time, may be related to DM risk among nurses working shifts.

Introduction

The timing of daily behaviors within the 24-hour day defines our chronotype (1). Sleep chronotype is the sleep pattern related to the preference for sleeping in the morning and evening during circadian rhythm, and it shows differences between individuals in the morning, intermediate, or evening form (2). Those in the morning sleep chronotype go to bed early and those in the evening sleep chronotype late (3). The evening chronotype is associated with the possibility of unhealthy food and nutrient intake, which may predict a higher risk of obesity than the morning preference (3). The prevalence of type 2 diabetes (T2D) and prediabetes is increasing worldwide, and by the end of 2030, more than 470 million people will be affected by prediabetes because of insulin resistance (4). In addition, sleep shorter than 8 hours is associated with obesity and glucose intolerance via increased appetite for high-energy foods (5,6).

Disruption of sleep patterns and sagging of the midpoint of sleep time due to changes in social obligations such as school or work is called social jetlag (2,7). Social jetlag is calculated as the continuously measured and bisected absolute difference in the midpoint of the sleep period between weekdays and weekend days. Values of 2 h or more are considered abnormal and indicate more shifts in sleep timing during the week (7-10). It is assumed that individuals with evening chronotypes are prone to abnormal jetlag (3) and sleep deprivation due to night and shift work will be compensated on free days (11).

Nursing is characterized by a working articulation in shifts to ensure continuity of care throughout the 24 hours (12). Several studies examined sleep quality, daytime sleepiness, or sleep chronotypes due to the work schedule of health workers, including night shifts (13). It has been explained among female workers that with prolonged years of exposure to shift work, the risk of T2D might increase (14).

The screening of nurses for diabetes risk was the focus of this study, which used the American Diabetes Association (ADA) Diabetes Risk tool. Additionally, the study sought to establish links between social jetlag, circadian preferences, and diabetes risk. Specifically, the effects of shift work and sleep patterns on the DM risk among nurses were investigated.

Methods

Study design, setting, and sample

This cross-sectional study was conducted face-to-face with the nurses between September and November 2021. The research population consisted of 1200 nurses working at a tertiary hospital. The required number for the sample group was calculated as at least 197 people using the calculation tool on the https://sampsize.sourceforge.net/ site, taking the diabetes risk rate as 32% in the sample literature (15), type 1 error rate 5% and power level as 90%. A target of 300 participants was randomly determined through the randomizer.org website based on a work date list obtained from the hospital's human resource management department, and the study was terminated when 212 nurses meeting the inclusion criteria were reached.

Study subjects included participants; nurses who volunteered to participate in the study as shift workers, nurses who did not suffer from psychiatric and neurological conditions, nurses who had not been previously diagnosed with diabetes and/or sleep disorders, pregnancy, and nurses who were not taking nutritional supplements (such as melatonin) or medications impairing sleep.

Instruments and data collection

The sociodemographic data form (age, gender, marital status, smoking, working profession, number of shifts), height, weight, sleep length, time to sleep, time to get up in the morning, Morningness-Eveningness Stability Scale improved (MESSi) and ADA diabetes risk assessment questionnaire were applied in line with the literature (15-17).

American Diabetes Association type 2 diabetes risk score calculation

When the total score obtained from the responses related to age, waist circumference, gestational diabetes, height, race/ethnicity, hypertension, family history, and exercise in the ADA T2D risk score is five or higher, it indicates a higher risk for diabetes, probability of pre-diabetes or undiagnosed diabetes and needs to be administered to a physician (16-19).

Morningness-Eveningness Stability Scale Improved

MESS is a novel instrument that consists of subscales of morning affect (MA), eveningness (EV), and stability/distinctness (DI) and is used to define participants' morningness-EV preference. The scale was developed by Randler et al. (18) in 2016 and adopted into Turkish by Demirhan et al. (16) in 2019. MESSi comprises 15 items with five choices (16). Questions 3, 4, 11, and 12 are reverse questions. Circadian fluctuations are related to mood or activation. The DI (amplitude of diurnal variation) subscale represents the subjective feeling of DI of daily changes. As the total score from the stability dimension increases, DI decreases; in other words, stability in mood increases (16,18). The Turkish form of the scale's Cronbach's alpha values for MA, EV, and DI were 0.84, 0.81, and 0.58, respectively (16). In our study, the MESSi scale's Cronbach's alpha values for MA, EV, and DI were found to be 0.83, 0.79, and 0.66.

Social jetlag calculation

"Social jetlag" was defined as the absolute difference in the midpoint of the sleep period between weekdays and weekends, measured continuously and dichotomized (2:2 hours), with higher values indicating more displacement of sleep timing across the week (7). For example, if a participant reported a sleep onset of 8:00 pm and wake time of 6:00 am on weekdays (midpoint: 1:00 am) and a 10:00 pm sleep onset and 10:00 am wake time on weekends (midpoint: 4:00 am), their social jetlag was 3 h (7).

Ethical approval

For the implementation of the study, permission was obtained from the İstanbul Provincial Health Directorate Gaziosmanpaşa Training and Research Hospital Clinical Research Ethics Committee with the date 08/09/2021 and no 324. The participants provided written informed consent.

Statistical Analysis

The collected research data were analyzed using the MediCres E-Picos Calculator online statistical program. The numerical data are shown as mean and standard deviation. The categorical data were given as numbers and percentages between groups with normal and abnormal jetlag and were compared using the chi-square and Fisher's exact test, and continuous data were compared using the Student's t-test. The Pearson correlation test was used to determine the relationships among circadian preferences, jetlag times, and diabetes risk score. Risk factors for diabetes mellitus (DM) risk probability were assessed using a binary logistic regression model. Statistical significance limit p<0.05 was accepted.

Results

The characteristics of the participants, sleep patterns and comparisons of normal and abnormal social jetlag groups are shown in Table 1. The mean age of the 212 nurses was 32.25±6.99 years. 83.5% (n=177) were female and 43.9% (n=93) were married. The average shift count of our study population was 4.21±3.78 (median=4) shifts. The rate of short sleepers whose sleep duration was less than 8 hours was 61.8%. The presence of social jetlag was detected in 18.9% (n=40). Participants with normal sleep duration and those with lower EV and higher MA scores had a higher likelihood of normal social jetlag than those with short sleep keepers, those with higher EV, and those with lower MA (p=0.009, p=0.004, p=0.003). Furthermore, those who slept longer on weekdays had a significantly higher chance of normal social jetlag than short sleep keepers (p<0.001). Additionally, nonsmokers were more inclined to experience normal social jetlag than smokers (p=0.029). It was observed that nurses with fewer than four monthly shifts had a lower diabetes risk than others (p=0.004).

In Table 2, comparisons of groups with and without diabetes risk are presented. ADA diabetes risk presence was 6.6% (n=14).

Table 1. Comparison of sociodemographic characteristics, sleep duration, circadian preferences and diabetes risk presence between groups with normal and abnormal social jetlag

Variables	Total n=212 (100%)	Normal social jetlag (<2 hours) n=172 (81.1%)	Abnormal social jetlag (≥2 hours) n=40 (18.9%)	p
Age, years, mean±SD	32.25±6.99	32.59±6.99	30.75±6.93	0.134*
Profession, years, mean±SD	10.13±7.19	10.37±7.20	9.10±7.12	0.324*
Monthly shift count, mean±SD	4.21±3.78	4.11±3.86	4.76±3.45	0.416*
≤4 shifts, n (%)	109 (52.4)	93 (54.1)	18 (45.0)	0.301
>4 shifts, n (%)	101 (47.6)	79 (45.9)	22 (55.0)	
BMI, mean±SD	23.67±4.70	23.69±4.76	23.58±4.53	0.900
Sex, n (%)				
Female	177 (83.5)	144 (83.7)	33 (82.5)	0.851
Male	35 (16.5)	28 (16.3)	7 (17.5)	
Marital status, n (%)				
Married	93 (43.9)	76 (44.2)	17 (42.5)	0.847
Single/divorced	119 (56.1)	96 (55.8)	23 (57.5)	
Smoking, n (%)				
Smoker	65 (30.7)	47 (27.3)	18 (45.0)	**0.029***
Non-smoker	147 (69.3)	125 (72.7)	22 (55.0)	
Sleep duration, n (%)				
Short (<8 hour) sleep	131 (61.8)	99 (57.6)	32 (80.0)	**0.009***
Normal sleep	81 (38.2)	73 (42.4)	8 (20.0)	
Weekday sleep duration, mean±SD	7.54±1.62	7.74±1.59	6.65±1.44	**<0.001***
Weekend sleep duration, mean±SD	8.9±1.42	8.84±1.38	9.17±1.55	0.187
MA score, mean±SD	16.66±3.55	17.01±3.39	15.15±3.84	**0.003***
EV score, mean±SD	15.15±3.97	14.78±3.97	16.75±3.59	**0.004***
DI score, mean±SD	14.95±3.31	15.11±3.28	14.25±3.39	0.137
ADA diabetes risk screening, n (%)				
DM risk positive	14 (6.6)	12 (7.0)	2 (5.0)	0.650***
DM risk negative	198 (93.4)	160 (93.0)	38 (95.0)	

*Student's t-test, **chi-square test, ***Fisher's exact test, p<0.05 is significant MA, EV, and stability/DI.
MA: Morning affect, EV: Eveningness, DI: Distinctness, BMI: Body mass index, ADA: American Diabetes Association, DM: Diabetes mellitus, SD: Standard deviation

It was observed that nurses with fewer than four monthly shifts had a higher risk of diabetes than others (p=0.004). Participants with diabetes risk had an older age (p<0.001), longer job experience (p<0.001), lower night shift count (p=0.010), higher body mass index (BMI) (p<0.001), and male sex (p=0.006) versus diabetes risk negative group (Table 2). No significant difference was observed in the presence of abnormal jetlag between the groups with and without DM risk, as presented in Table 1.

Table 3 shows the comparison of social jetlag, MA, EV, and DI scores between groups of sex, marital status, smoking, sleep duration (hour) and diabetes risk. Males had a higher DI score than females (p=0.014). MA score was higher in married nurses than in single/divorced group (17.23±3.04 vs. 16.21±385; p=0.040). Short sleep keepers had a higher social jetlag time than normal sleep keepers (1.34±0.89 vs. 0.92±0.97; p=0.005). The DM risk-positive group had a lower EV than the negative group (13.07±3.56 vs. 15.29±3.96; p=0.042). Furthermore, smokers had longer social jetlag than non-smokers (1.40±0.99 vs. 1.09±0.91; p=0.026), higher EV scores (16.23±3.82 vs. 14.67±3.96; p=0.011), and lower MA scores (15.46±4.28 vs. 17.19±3.04; p=0.005). The group of rare shifts (≤4 shift count) had higher MA (17.35±3.44 vs. 15.90±3.52; p=0.003) and DI (15.55±3.12 vs. 14.29±3.40; p=0.006) scores than those with over four shifts.

Table 2. Comparison of sociodemographic characteristics, sleep duration, and circadian preferences between ADA diabetes risk screening questionnaire groups with and without diabetes risk

Variables	ADA diabetes risk positive n=14 (6.6%)	ADA diabetes risk negative n=198 (93.4%)	p
Age, years, mean±SD	43.43±5.21	31.45±6.42	**<0.001***
Profession, years, mean±SD	22.36±5.70	9.25±6.45	**<0.001***
Monthly shift count, mean±SD	1.68±2.75	4.50±3.78	**0.010***
≤4 shifts, n (%)	13 (92.9)	98 (49.5)	**0.004*****
>4 shifts, n (%)	1 (7.1)	100 (50.5)	
BMI, mean±SD	29.28±4.31	23.24±4.48	**<0.001***
Sex, n (%)			
Female	8 (57.1)	169 (85.4)	**0.006****
Male	6 (42.9)	29 (14.6)	
Marital status, n (%)			
Married	9 (64.3)	84 (42.4)	0.111
Single/divorced	5 (35.7)	114 (57.6)	
Smoking, n (%)			
Smoker	4 (28.6)	61 (30.8)	0.861
Non-smoker	10 (71.4)	137 (69.2)	
Sleep duration, n (%)			
Short sleep keepers	9 (64.3)	122 (61.6)	0.843
Normal sleep keepers	5 (35.7)	76 (38.4)	
Weekday sleep duration, mean±SD	7.21±1.11	7.57±1.65	0.431
Weekend sleep duration, mean±SD	8.37±1.28	8.94±1.42	0.146

*Student's t-test, **chi-square test, ***Fisher's exact test, p<0.05 is significant. BMI: Body mass index, ADA: American Diabetes Association, SD: Standard deviation

Table 4 shows the correlation analysis of social jetlag duration and circadian preferences toward age, weekday sleep duration, weekend sleep duration, BMI, and ADA T2D screening scores. The DI score positively correlated with the ADA score (r=0.168; p=0.014), age (r=0.140; p=0.031), and a negative correlation with the monthly shift count (r=-0.149; p=0.022). The MA negatively correlated with the shift count (r=-0.164; p=0.018).

However, there was a negative relationship between age and night shift count (r=-0.395; p<0.001).

The risk factors for DM risk were assessed with a binary logistic regression model (Table 5). Higher values of BMI [odds ratio (OR)=1.255; 95% confidence interval (CI): 1.036-1.520; p=0.020] and male sex (OR: 7.350; 95% CI: 1.265-42.161; p=0.026) were associated with increased risk of DM.

Discussion

The current research achieved associations between circadian sleep preferences, social jet lag, and diabetes risk screening results among nurses working shifts. The DM risk was 6.6% and the frequency of abnormal social jetlag was 18.9%. A higher risk of DM was related to lower EV and had a positive relationship with DI. It was concluded that circadian preference, but not social jetlag time, may be related to DM risk. Male nurses with a higher BMI were found to be at the highest risk of developing DM.

A literature review for nurse health has shown that shift working is a risk factor for DM (12). Globally, 41 million individuals are estimated to have prediabetes, defined as impaired fasting glucose or impaired glucose tolerance. Prediabetes implies an increased risk of development of T2D on the order of 30% over 4 years (20). In the region where this study was conducted, İğci and Basat (15) performed ADA T2D screening and found the DM risk to be 32% in the general population who applied to the same hospital's family medicine clinic. Kulak et al. (21) found a high to very high risk for DM (19.3%) and a moderate risk (22.2%) in another study. The prevalence of prediabetes among young adults was 24.0% in the United States (22). Therefore, a DM screening risk of 6.6% may be considered as a low incidence. This result may be associated with the fact that our sample included health professionals.

Table 3. Comparison of social jetlag, MA, EV, and DI scores between groups of sex, shift count, marital status, smoking, sleep duration (hours) and diabetes risk

		Social jetlag (hours)	MA	EV	DI
Sex	Female	1.16±0.93	16.55±3.54	15.24±4.06	14.71±3.20
	Male	1.31±0.99	17.22±3.55	14.71±3.55	16.20±3.64
p		0.392	0.300	0.478	**0.014***
Monthly shift count	≤4 shifts	1.18±0.80	17.35±3.44	14.82±4.50	15.55±3.12
	>4 shifts	1.19±1.07	15.90±3.52	15.52±3.29	14.29±3.40
p		0.928	**0.003***	0.198	**0.006***
Marital status	Married	1.20±0.88	17.23±3.04	14.91±4.42	15.28±3.26
	Single/divorced	1.18±0.98	16.21±385	15.34±3.59	14.69±3.35
p		0.888	**0.040***	0.444	0.205
Smoking	Smoker	1.40±0.99	15.46±4.28	16.23±3.82	14.80±3.58
	Non-smoker	1.09±0.91	17.19±3.04	14.67±3.96	15.02±3.19
p		**0.026***	**0.005***	**0.011***	0.729
Sleep duration (hour)	Short sleep keepers (%)	1.34±0.89	16.81±3.53	15.09±4.10	15.06±3.26
	Normal sleep keepers (%)	0.92±0.97	16.41±3.58	15.23±3.78	14.78±3.41
p		**<0.001***	0.415	0.810	0.546
ADA diabetes risk screening test result	DM risk positive	1.21±0.70	17.57±3.25	13.07±3.56	15.57±4.16
	DM risk negative	1.18±0.96	16.59±3.56	15.29±3.96	14.91±3.25
p		0.908	0.321	**0.042***	0.471

*Student's t-test, p<0.05.
MA: Morning affect, EV: Eveningness, DI: Distinctness, ADA: American Diabetes Association, DM: Diabetes mellitus

Table 4. Correlation analysis of social jetlag duration and circadian preferences towards age, weekday sleep duration, weekend sleep duration, BMI, and ADA type 2 diabetes screening score

Variables	Social jetlag (hours)	MA	EV	DI
Age	r=0.014 p=0.834	r=0.111 p=0.109	r=-0.129 p=0.060	**r=0.140 p=0.042**
Profession, years	r=0.013 p=0.855	r=0.131 p=0.060	r=-0.130 p=0.064	r=0.062 p=0.062
Monthly shift count	r=-0.006 p=0.926	**r=-0.164 p=0.018***	r=0.084 p=0.229	**r=-0.149 p=0.031***
Weekday sleep duration	**r=-0.293 p<0.001***	r=0.007 p=0.916	r=-0.059 p=0.396	r=-0.025 p=0.715
Weekend sleep duration	**r=0.190 p=0.005***	r=-0.045 p=0.511	r=-0.044 p=0.520	r=-0.052 p=0.455
ADA diabetes risk screening score	r=-0.005 p=0.941	r=0.111 p=0.109	r=-0.118 p=0.086	**r=0.168 p=0.014***
BMI	r=0.014 p=0.996	r=0.165 p=0.165	r=0.028 p=0.690	r=0.087 p=0.206

*p<0.05 Pearson correlation test.
MA: Morning affect, EV: Eveningness, DI: Distinctness, BMI: Body mass index, ADA: American Diabetes Association, DM: Diabetes mellitus

Morningness is usually associated with well-being, better sleep quality, and more conscientiousness, whereas EV is associated with negative emotionality, poorer sleep quality, and less conscientiousness (23). In addition, evening-oriented sleep timing preferences have been related to the risk of diabetes, cardiovascular diseases, obesity, psychiatric disorders, and increased mortality (1). In contrast, the DM risk-positive nurse group had a lower EV and higher DI (amplitude of diurnal variation) score than the other groups in our study. In addition, DM risk presence was significant for longer work experience and less night shift count versus others. We thought it might be related to older nurses having higher DM risk, longer work

Table 5. Evaluation of ADA diabetes risk entity with logistic regression test

Variables	Presence of risk in ADA type 2 diabetes screening test result		
	OR	95% CI	p
Age, year	1.065	0.797-1.423	0.669
Sex (reference: male)	7.350	1.265-42.161	**0.026***
Profession, year	1.192	0.916-1.550	0.191
Monthly shift count (reference: ≤4 shifts)	10.185	0.425-244.066	0.152
BMI kg/m^2	1.255	1.036-1.520	**0.020***
EV score	0.927	0.762-1.138	0.488

*p<0.05 binary logistic regression test.
EV: Eveningness, BMI: Body mass index, ADA: American Diabetes Association, OR: Odds ratio, CI: Confidence interval

experience, and fewer night shifts than younger nurses, as expected. Usually, 90% of the adult population is diagnosed with T2D at over 45 years of age (24). Similarly, in our study, the mean age of participants with diabetes risk was 43.43±5.21 years while the mean age of our study population was 32.25±6.99 years.

The prevalence of prediabetic syndrome, which means diabetes risk, is sexually biased in all populations studied (25). The male gender was significant for our study's DM risk screening results, but our search did not confirm it with glucose measures confirming prediabetic syndrome.

Vagos et al. (26) demonstrated that both EV and DI negatively correlated with age. Females are not different from males in MA but score significantly lower on EV and higher on DI. In the study by Rahafar et al. (27), men reported higher MA than women, whereas women reported higher DI than men. Regarding the country effect, Iranian participants reported the highest MA compared to Spaniards and Germans, whereas Germans reported higher DI than Iranians and Spaniards. Díaz-Morales and Puig-Navarro (28) showed in adolescents that boys reported higher morningness, whereas girls reported higher DI. In contrast, our study found that females had a lower DI score, and age had a positive correlation with the DI score. MA and EV scores were similar between males and females. We thought that gender and DI could change according to cultural features or occupations to explain the opposite results of our study.

Maidstone et al (29). divided a study population as day workers, shift workers, irregular shift workers and permanent night shift workers. They observed higher odds of asthma as a chronic disease in shift workers who never or rarely worked night shifts when compared with day workers. In our study, DI was related to older age and rare shift counts. However, age was negatively related to shift counts. Rare shift working may explain the association between older age and higher DI cause of rare shift counts of older nurses in our sampling.

The risk of developing T2D is 30% higher in those who slept 5 hours a day than in those who slept 7-8 hours (30). In our study, short sleep duration was accepted below 8 hours, but there was no difference in DM risk between short sleep keepers and other nurses.

In a study conducted with university students, the level of social jetlag was associated with a loss of sleep duration and increased BMI (31). A cohort study found that social jetlag was associated with an increased risk of diabetes/prediabetes (32) and predicted higher HbA1c levels in patients with T2D (33). Our study did not find any difference in social jetlag between the groups with and without DM risk.

A high level of social jetlag was linked to EV (34). Similarly, we found that nurses with abnormal social jetlag had higher EV. Didikoglu et al. (1) showed that an evening-type cluster was associated with traits related to increased smoking. The study of Başpınar and Basat (35) showed that while the ADA diabetes risk of smokers is 20.5%, there would be an increased risk of diabetes due to weight gain after quitting. Therefore, combining never-smokers and ex-smokers may have been a limitation for screening DM risk in this study. However, we found that smokers had a prolonged social jetlag time, higher EV, and lower MA than nonsmokers.

This study has several limitations. We performed screening through self-report. MESSi is a self-report questionnaire, but the gold methods for detecting chronotypes are monitoring techniques (e.g., core body temperature and melatonin levels) or altimetry as a noninvasive method (36). Similarly, the ADA T2D risk screening test is another self-report questionnaire. Therefore, self-reporting is a limitation of this present study, but MESSi and ADA tools were chosen because they are fairly simple and economically cost-effective methods. Finally, the number of people at risk of diabetes was low. Therefore, using a small sample size and a limited study group caused the results of our study not to be generalized. Studies with larger sample groups are required.

Conclusion

Participants with abnormal jetlag had circadian preference differences compared with normal subjects. No relationship was detected between social jetlag and DM risk. However, we concluded that circadian preferences such as DI and lower EV may be related to DM risk among nurses working shifts.

Ethics

Ethics Committee Approval: Ethical approval was obtained from İstanbul Provincial Health Directorate Gaziosmanpaşa Training and Research Hospital Clinical Research Ethics Committee with the date 08/09/2021 and no 324.

Informed Consent: The nurses included in the study were informed about the study, and their written consent was obtained.

Authorship Contributions

Concept: M.M., M.M.B., Y.T., Design: M.M., M.M.B., Y.T., Data Collection or Processing: M.M., M.M.B., Y.T., Analysis or Interpretation: M.M., M.M.B., Literature Search: M.M., M.M.B., Y.T., Writing: M.M., M.M.B., Y.T.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Didikoglu A, Maharani A, Payton A, Pendleton N, Canal MM. Longitudinal change of sleep timing: association between chronotype and longevity in older adults. Chronobiol Int. 2019;36:1285-1300.
2. Taillard J, Sagaspe P, Philip P, Bioulac S. Sleep timing, chronotype and social jetlag: Impact on cognitive abilities and psychiatric disorders. Biochem Pharmacol. 2021;191:114438.
3. Maukonen M, Kanerva N, Partonen T, et al. The associations between chronotype, a healthy diet and obesity. Chronobiol Int. 2016;33:972-981.
4. Aldayel FA, Belal MA, Alsheikh AM. The validity of the American Diabetes Association's diabetes risk test in a Saudi Arabian population. Cureus. 2021;13:e18018.
5. Araghi MH, Jagielski A, Neira, et al. The complex associations among sleep quality, anxiety-depression, and quality of life in patients with extreme obesity. Sleep. 2013;36:1859-1865.
6. Tasali E, Chapotot F, Wroblewski K, Schoeller D. The effects of extended bedtimes on sleep duration and food desire in overweight young adults: a home-based intervention. Appetite. 2014;80:220-224.
7. Johnson DA, Reid M, Vu TT, et al. Associations of sleep duration and social jetlag with cardiometabolic risk factors in the study of Latino youth. Sleep Health. 2020;6:563-569.
8. Henderson SE, Brady EM, Robertson N. Associations between social jetlag and mental health in young people: A systematic review. Chronobiol Int. 2019;36:1316-1333.
9. Jankowski KS. Social jet lag: Sleep-corrected formula. Chronobiol Int. 2017;34:531-535.
10. Kim YE, Kim HR. Relationship between Smartphone Usage Time and Oral Health among Korean Adolescents: The 13th Korea Youth Risk Behavior Survey (2017). Journal of the Korea Academia-Industrial cooperation Society. 2020;21:309-316.
11. Casjens S, Brenscheidt F, Tisch A, et al. Social jetlag and sleep debts are altered in different rosters of night shift work. Plos One. 2022;17:e0262049.
12. Rosa D, Terzoni S, Dellafiore F, Destrebecq A. Systematic review of shift work and nurses' health. Occup Med (Lond). 2019;69:237-243.
13. Akçay D, Yıldırımlar A, Aksu S. Factors Affecting Sleep Status of Nurses. Turkiye Klinikleri J Nurs Sci. 2021;13:105-113.
14. Gao Y, Gan T, Jiang L, et al. Association between shift work and risk of type 2 diabetes mellitus: a systematic review and dose-response meta-analysis of observational studies. Chronobiol Int. 2020;37:29-46.
15. İğci MA, Basat O. Determine Type 2 Diabetes Development Risk In Adult Patients Presenting to Family Medicine Department of Gaziosmanpaşa Taksim Training and Research Hospital Using Diabetes Risk Assessment Test. Namik Kemal Med J. 2019;7:53-60.
16. Demirhan E, Önder İ, Horzum MB, Masal E, Beşoluk Ş. Adaptation of the Morningness-Eveningness Stability Scale improved (MESSi) into Turkish. Chronobiol Int. 2019;36:427-438.
17. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2014;37(Suppl 1):S81-90.
18. Randler C, Díaz-Morales JF, Rahafar A, Vollmer C. Morningness-eveningness and amplitude - development and validation of an improved composite scale to measure circadian preference and stability (MESSi). Chronobiol Int. 2016;33:832-848.
19. American Diabetes Association Professional Practice Committee. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2022. Diabetes Care. 2022;45(Suppl 1):17-38.
20. Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002;346:393-403.
21. Kulak E, Berber B, Temel H, et al. Determination of type 2 diabetes risk levels in individuals applying to family medicine. Turkish Journal of Family Practice. 2019;23:20-30.
22. Nobili V, Mantovani A, Cianfarani S, et al. Prevalence of prediabetes and diabetes in children and adolescents with biopsy-proven non-alcoholic fatty liver disease. J Hepatol. 2019;71:802-810.
23. Carciofo R. Morning affect, eveningness, and amplitude distinctness: Associations with behavioural indicators of conscientiousness. Chronobiol Int. 2022;39:1590-1600.
24. Hillier TA, Pedula KL. Characteristics of an adult population with newly diagnosed type 2 diabetes: the relation of obesity and age of onset. Diabetes care. 2001;24:1522-1527.
25. Mauvais-Jarvis F. Gender differences in glucose homeostasis and diabetes. Physiol Behav. 2018;187:20-23.
26. Vagos P, Rodrigues PF, Pandeirada JN, et al. Factorial structure of the Morningness-Eveningness-Stability-Scale (MESSi) and sex and age invariance. Front Psychol. 2019;10:3.
27. Rahafar A, Randler C, Díaz-Morales JF, Kasaeian A, Heidari Z. Cross-cultural validity of Morningness-Eveningness Stability Scale improved (MESSi) in Iran, Spain and Germany. Chronobiol Int. 2017;34:273-279.
28. Díaz-Morales JF, Puig-Navarro Y. The psychometric properties of the Spanish version of the Morningness-Eveningness Stability Scale improved (MESSi) in adolescents. Chronobiol Int. 2022;39:1411-1418.
29. Maidstone RJ, Turner J, Vetter C, et al. Night shift work is associated with an increased risk of asthma. Thorax. 2021;76:53-60.

30. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Quantity and quality of sleep and incidence of type 2 diabetes: a systematic review and meta-analysis. Diabetes Care. 2010;33:414-420.

31. Bodur M, Baspinar B, Özçelik AÖ. A cross-sectional evaluation of the relationship between social jetlag and diet quality. Chronobiol Int. 2021;38:1557-1568.

32. Koopman ADM, Rauh SP, van 't Riet E, et al. The association between social jetlag, the metabolic syndrome, and type 2 diabetes mellitus in the general population: the new Hoorn study. J Biol Rhythms. 2017;32:359-368.

33. Kelly RM, Finn J, Healy U, et al. Greater social jetlag associates with higher HbA1c in adults with type 2 diabetes: a cross sectional study. Sleep Med. 2020;66:1-9.

34. Saxvig IW, Evanger LN, Pallesen S, et al. Circadian typology and implications for adolescent sleep health. Results from a large, cross-sectional, school-based study. Sleep Med. 2021;83:63-70.

35. Başpınar MM, Basat O. Does a High Pre-Treatment Nicotine Dependence Increase the Post-Cessation Diabetes Risk? Turkish Journal of Family Medicine and Primary Care. 2021;15:244-250.

36. Öğütlü H, Uygun SD, Randler C. Psychometric properties of the Turkish version of the Morningness-Eveningness Stability Scale improved (MESSi) in adolescents. Chronobiol Int. 2021;38:1650-1658.