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Sleep Quality of Diabetic Patients with Metabolic Syndrome, Is There A Difference?

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Abstract: Poor sleep quality is a prevalent health problem among patients with diabetes. Metabolic syndrome (MetS) is common in type 2 diabetic patients and associated with morbidity and mortality. We aimed to investigate sleep quality among type 2 diabetes patients according to their metabolic syndrome status. This was an analysis of data collected from 189 adult type 2 diabetic patients. The patients divided into two groups (metabolic and non-metabolic) based on the presence of MetS. Anthropometric measurements, blood pressure, and serum glucose, lipid levels were collected. The Pittsburgh Sleep Quality Index (PSQI) calculated for all patients. There was no significant difference in subjective sleep quality scores between the two groups ($p > 0.05$). However, there was a significant difference in sleep latency scores between the two groups; the scores of patients with MetS were lower than those of patients without MetS ($p = 0.010$, $p < 0.05$).Sleep quality was low in 57.1% ($n = 108$) of patients with diabetes. Poor sleep is common among diabetic patients, but in this study, metabolic syndrome existence not associated with sleep quality in type 2 diabetic patients.
Keywords: metabolic syndrome; diabetes; sleep quality

INTRODUCTION

Metabolic Syndrome (MetS) refers to a constellation of three or more of the following concomitant conditions that confer increased cardiovascular risk: abdominal obesity, hyperglycemia or insulin resistance, hypertriglyceridemia, reduced high-density lipoprotein levels, and hypertension. Patients fulfilling these criteria show an increased incidence of multiple health conditions[1]. An important application of this definition of MetS is in the daily clinical assessment of patients to identify those at with a higher risk of type 2 diabetes or cardiovascular disease. For patients with diabetes, MetS criteria can be useful to assess the risk of progression and cardiovascular disease risk.

Sleep deprivation reportedly reduces insulin sensitivity[2], and poor sleep quality is a prevalent problem among patients with diabetes, and approximately 53.4% of the patients with diabetes experiencing poor quality of sleep compared to the 29% of the general population[3].

In this study, we aimed to investigate the effect of MetS on sleep quality in diabetic patients. Also, we investigated whether there is a relationship between sleep

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quality and MetS components, such as blood triglyceride levels, fasting blood glucose, and waist circumference in patients with diabetes. Finally, we determined whether sleep problems are associated with MetS development. There is no study previously that compares sleep quality between two groups: Type 2 Diabetes patients with Metabolic Syndrome and without Metabolic Syndrome.

MATERIALS AND METHODS

Between 06.October.2017, and 02.October.2018, 189 randomly patients with type 2 diabetes who referred to the Endocrinology or Internal Medicine clinic who met the inclusion criteria were enrolled. The patients divided into two groups (metabolic and non-metabolic) based on the presence of MetS and written informed consent obtained before the data collection and analysis. The ethics committee approved the study of the Fatih Sultan Mehmet Hospital Clinical Research Ethics Committee (Istanbul, Turkey).

Exclusion Criteria: Exclusion criteria were the presence of known CVD, recent hospitalization for mental illness, neurologic disease, medication, or other health conditions that would affect the sleep cycle.

Anthropometric Measurements: Standard methods measured height and weight, and body mass index (BMI) calculated. Using a height measurement scale with an accuracy of 0.1 cm, heights of the patients were measured while they had no shoes on, we are in a standing position, looked straight ahead and put the shoulders and back of the feet in one direction. Using a weighing scale with an accuracy of 0.1 kg, weights of the patients were measured twice while they had no shoes on and wore minimum clothing and also after excretion. In the case of a difference of >0.1 kg between two measurements, the mean calculated after a third measurement.

BMI was calculated by dividing weight (in kg) by the square of height (in m). Patients with BMIs of <24.9, 25.0–29.9, and≥30.0 kg/ m^2 classified as normal, overweight, and obese, respectively. Waist circumference measured using a steel measuring tape, with measurements made halfway between the lower border of the ribs and the iliac crest on a horizontal plane. Females with waist circumferences of 80–87.9 cm and ≥88.0 cm were classified as overweight and obese, respectively.

The Pittsburgh Sleep Quality Index (PSQI) is a validated self-rated questionnaire that assesses sleep quality and disturbance over a 1-month time interval. In all, 19 items generate seven component scores reflecting sleep problems in the areas of subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. Each component is given a score between zero and three points. These scores are then combined to generate an overall PSQI score. The maximum PSQI score is 21 points, determined by the sum of the scores of all the seven components. Higher scores indicate the more reduced quality of sleep. It is common to classify subjects into two groups: good (PSQI ≤ 5) and poor sleepers (PSQI > 5). PSQI is an instrument that assesses subjective sleep quality and related disorders. The original validated instrument has 89.6% sensitivity and 86.5% specificity[4].

Data collected from the face- to- face interviews conducted in a previously prepared, peaceful, and comfortable room. Subjects asked to sign a voluntary informed consent form before the interview.

Statistical Analysis: Student's t-test used for two-group comparisons of the variables with normal distribution and the comparison of descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum and maximum) as well as quantitative data. Mann–Whitney U test used for two-group comparisons. One-way ANOVA used for three-group comparisons of variables with a normal distribution. Pearson's chi-square test used for the comparison of qualitative data. Significance was evaluated at $p < 0.05$. NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) used for statistical analysis.

RESULT AND DISCUSSION

Of the 180 patients included in the study, 60.3% (n = 114) were females and 39.7% (n= 75) were males. The average patient age was 55.10 ± 10.42 (range, 24–80 years). There was no significant difference in subjective sleep quality scores between the two groups ($p > 0.05$). However, there was a significant difference in sleep latency scores between the two groups; the scores of patients with MetS were lower than those of patients without MetS ($p = 0.010$, $p < 0.05$). However, sleep duration, usual sleep activity, sleep disturbance, sleep medication use, and daytime sleep dysfunction scores did not significantly differ between the two groups ($p > 0.05$).

The mean total PSQI scores of patients with and without MetS were 6.48 ± 4.05 and 6.21 ± 3.56, respectively. However, there was no significant difference in total PSQI scores between the two groups ($p > 0.05$). There was no significant relationship found between triglyceride and PSQI total scores (p> 0.05). Finally, there was no significant relationship between BMI and PSQI total scores (p> 0.05), as evidenced by no statistically significant difference in total PSQI scores according to BMI.

Table 1: Demographics Distribution

Demographic features	Category	n (%)
Age (n=180)	Min-Max (Median)	24-80 (56)
years	Mean	55,10±10,42
Gender	Female	114 (60,3)
	Male	75 (39,7)
Body weight (kg) (n=185)	Min-Max (Median)	48-149 (88)
	Mean	88,59±15,69He
Height (cm) (n=185)	Min-Max (Median)	130-186 (161)
	Mean	161,99±8,86
BMI (kg/m^2) (n=185)	Min-Max (Median)	21,2-50 (33)
	Mean	33,75±6,05
	Normal	8 (4,3)
	Overweight	40 (21,6)
	Obese	111 (60,0)
	Extreme Obese	26 (14
Waist Circumference	Min-Max (Median)	61-148 (110)
(cm) (n=177)	Mean	109,46±14,00
Duration of Diabetes	Min-Max (Meidan)	0,00-30 (10)
(year) (n=179)	Mean	9,15±6,65

Table 2: Metabolic Syndrome and Sleep Score

Category		n (%)
Metabolic syndrome	-	51 (27,0)
	+	138 (73,0)
Metabolic Syndrome Criteria (+)	*Min-Max (Median)*	1-5 (3)
	Mean ± Ss	3,20 ± 1,18
	Score 1	20 (10,6)
	Score 2	31 (16,4)
	Score 3	54 (28,6)
	Score 4	59 (31,2)
	Score 5	25 (13,2)
Sleep Score	*Min-Max (Median)*	0-44 (14)
	Mean ± Sd	14,66 ± 9,14

Table 3: Distribution of Laboratory Results

Laboratory Results		
HbA1c (n=167)	Min-Max (Median)	5,2-15 (8,7)
	Mean ± sd	8,99±2,08
Triglyceride (n=169)	Min-Max (Median)	34-694 (162)
	Mean ± sd	194,95±112,51
HDL (n=161)	Min-Max (Median)	23-201 (42)
	Mean ± sd	45,13±20,63
LDL (n=158)	Min-Max (Median)	36-400 (124)
	Mean ± sd	127,72±46,87
Blood Glucose (n=142)	Min-Max (Median)	46-403 (180,5)
	Mean ± sd	194,49±79,46
Systolic Blood Pressure (n=171)	Min-Max (Median)	90-210 (140)
	Mean ± sd	142,90±23,11
Diastolic Blood Pressure (n=170)	Min-Max (Median)	50-180 (85)
	Mean ± sd	85,36±15,90

Table 4: Pittsburg Sleep Quality Components Mean In All Study Population

Subjective Sleep Quality	Min-Max (Median)	0-3 (1)
(n=183)	Mean ± Ss	1,20±0,94
Sleep Latancy	Min-Max (Median)	0-3 (1)
(n=187)	Mean ± Ss	1,22±0,98
Sleep Duration	Min-Max (Median)	0-3 (0)
(n=187)	Mean ± Ss	0,88±1,10
Conventional sleeping	Min-Max (Median)	0-3 (1)
activity (n=185)	Mean ± Ss	0,85±1,02
Sleep Disorder	Min-Max (Median)	0-3 (1)
(n=185)	Mean ± Ss	1,38±0,76
Use of Sleep Medication	Min-Max (Median)	0-3 (0)
(n=172)	Mean ± Ss	0,20±0,71
Daytime Sleep Disorder	Min-Max (Median)	0-3 (0)
(n=176)	Mean ± Ss	0,86±1,02
	Min-Max (Median)	0-20 (6)
PSQI Total Points	Mean ± Ss	6,41±3,93
(n=169)	<5 points	61 (36,1)
	≥5 points	108 (63,9)

Table 5: Pittsburg Sleep Quality Index Components Between Groups

Pittsburg Sleep Quality Index		Metabolic syndrome (+)	Metabolic syndrome (-)
Subjective Sleep Quality	Min-Max (Median)	0-3 (1)	0-3 (1)
(n=183)	Mean ± Ss	1,26±0,95	1,02±0,90
Sleep Latancy	Min-Max (Median)	0-3 (1)	0-3 (1)
(n=187)	Mean ± Ss	1,10±0,94	1,54±1,03
Sleep Duration	Min-Max (Median)	0-3 (0)	0-3 (1)
(n=187)	Mean ± Ss	0,80±1,08	1,08±1,16
Conventional sleeping	Min-Max (Median)	0-3 (1)	0-3 (1)
activity (n=185)	Mean ± Ss	0,84±1,00	0,90±1,07
Sleep Disorder	Min-Max (Median)	0-3 (1)	0-3 (1)
(n=185)	Mean ± Ss	1,41±0,75	1,30±0,79
Use of Sleep Medication	Min-Max (Median)	0-3 (0)	0-3 (0)
(n=172)	Mean ± Ss	0,24±0,77	0,07±0,46
Daytime Sleep	Min-Max (Median)	0-3 (1)	0-3 (0)
Disorder (n=176)	Mean ± Ss	0,92±1,05	0,72±0,91
PSQI Total Points (n=169)	Min-Max (Median)	0-20 (6)	0-16 (6)
	Mean ± Ss	6,48±4,05	6,21±3,56
	<5 points	48 (37,8)	13 (31,0)
≥5 points	79 (62,2)	29 (69,0)	

[a]*Student t-Test* [c]*Mann Whitney U Test *p<0,05*

Table 6: Associations With PSQI

		PSQI total points		*p*
		Min-Max (Median)	Ave ± Ss	
Age (years) *(n=180)*	r	0,082		
	p	*0,302*		
Sex	Female	0-20 (6)	6,70±3,86	[a]*0,251*
	Male	0-16 (5)	5,99±4,02	
BMI (kg/m^2) *(n=185)*	r	-0,040		
	p	*0,611*		
	Normal	1-12 (4)	5,43±4,50	[d]*0,865*
	Light-Weighted	0-14 (6,5)	6,72±3,94	
	Obese	1-20 (6)	6,43±3,89	
	Extreme obese	0-16 (6)	6,15±4,34	
Diabetes duration (years)*(n=179)*	r	0,073		
	p	*0,378*		
HbA1c *(n=167)*	r	0,141		
	p	*0,083*		

MetS ratio, determined according to the National Cholesterol Education Program Adult Treatment Panel III was 73% in patients with diabetes included in our study. This ratio has reported being 33.9% in the normal Turkish population[5]. In another study, this ratio was as high as 87.2 % in patients with diabetes[6]. MetS is associated with low sleep quality. A cross-sectional study has reported that night-shift work was independently associated with a two-fold increase in the risk of MetS. Moreover, night shift workers showed significantly poorer sleep quality, increased sleep latency, decreased sleep duration, sleep disturbances, and daytime dysfunction[7]. In another study, poor sleep quality was associated with insulin resistance in postmenopausal females with or without MetS. Females with the worst sleep quality showed significantly higher HOMA2-IR values than women in all other quartiles[8].

In this study, the PSQI mean was 6,41±3,93. Sleep quality was low in 57.1% (n = 108) of patients with diabetes. Reportedly, sleep disturbances and diabetes mellitus linked to impaired glucose tolerance[9]. In a study, 796 people, who slept for <5 hours per day, had more waist circumference and frequent MetS[10]. In the Sleep Heart Health Study, an increased risk of hypertension found in patients who slept for <6 hours or >8–9 hours per day[11]. According to a survey conducted at the University of Pittsburgh, patients with type 2 diabetes showed low PSQI scores. Sleep disorders were more frequent in diabetic patients than in healthy individuals (33.7% ([n = 184)] and 8.2% ([n = 99),], respectively; p <0.01)[12]. In a study conducted in Brazil, 48% of the patients showed poor sleep quality indicated by PSQI scores[13]. Another study in the United States, this rate was 55% of 300 patients, which is similar to the rate in our study[14].

The mechanism can be defined as sleep restriction that alters the ability of leptin to accurately signal energy balance or decreased leptin levels that may represent a normal adaptation in response to the increased calorie need of long-term alertness[15]. Sleep onset stops recovery after a meal and reduces ghrelin levels to morning fasting values. In a randomized crossover study by Spiegel in 2004, ghrelin levels increased by 28% despite 2 hours of sleep[16]. This increase in ghrelin level following sleep loss has confirmed in subsequent studies[17]. After 4 hours of sleep for four days, glucagon-like peptide 1 (GLP-1) levels in the afternoon were lower in women but not in men. GLP-1 is a gut-derived peptide that delays gastric emptying and promotes saturation[18].

The present study did not find any association between BMI and PSQI scores. Likewise, according to a study conducted in Turkey, there was no relationship between BMI and PSQI scores, and the females with poor sleep quality consumed significantly more bread, but no other foods, than the females with good sleep quality[19]. In a large-scale study across six middles/low-income countries, no significant association of poor sleep quality with BMI and waist circumference found; however, high sleep quality found to be associated with high BMI and waist circumference in males in China and India. Different. These differences in patterns may be attributed to the socioeconomic differences between the two countries. Individuals with higher BMI in China and India have a higher socioeconomic status and may have been less exposed to adverse social stressors, subsequently reporting higher sleep quality scores[20]. Also, this study did not find any association between blood triglyceride and PSQI. This result was similar in other studies. It was similar to some studies in the literature[21].

Therefore, our study proves that sleep disorders are common in patients with diabetes (57.1%); however, when classified based on the MetS status, there was no significant difference in terms of sleep quality. This may be due to the socioeconomic structure of Turkey (BMI may be higher in patients with higher socioeconomic status and low-stress factors that can disrupt the sleep quality). and the advanced diabetes stage of our patients (mean HbA1c: 9.01% MetS diabetes with MetS and 8.7% diabetes without Mets. Another cognitive variant may be determined to assess the perception of sleep quality.

Limitations of this study include its single-center design and subjective assessment of sleep quality, Because of the high frequency of metabolic syndrome in diabetic patients, the group with MetS had more patients. Further data on sleep quality and MetS components may be obtained in large-scale studies, including more objective sleep assessments.

CONCLUSION

Sleep quality is a prevalent problem in diabetic patients. It can be more beneficial to reveal the association between diabetes and sleep deeply, sleep quality. This may extend in future diabetes evaluation or treatment in a different place. It will be beneficial to make to reveal the association between diabetes and sleep quality in future large-scale, multi-center studies in other regions.

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CONFLICT OF INTEREST

The authors declare no conflict of interest and have not received any funds for this study.

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