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Original Article

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Investigation of the Effect of Treatment Applied to Type 2 Diabetes Patients on Sleep Quality, Nutritional Habits and Biochemical Parameters during the COVID-19 Pandemic Process

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Abstract

Restrictions made during the COVID-19 pandemic have affected individuals' eating habits and sleep quality. This research was conducted to evaluate the sleep quality and nutritional habits of individuals diagnosed with Type 2 diabetes during the COVID-19 pandemic process, and to investigate the effect of sleep quality and nutritional habits on biochemical parameters.

It was carried out with 94 volunteers diagnosed with type 2 diabetes between the ages of 35-75, who applied to the Endocrinology, Metabolism and Internal Diseases polyclinic of Biruni University Hospital in Istanbul between December 2020 and February 2021.In the study; A questionnaire containing information about the sociodemographic characteristics of the individuals, their eating habits, the pandemic process, Pittsburgh Sleep Quality Index (PUKI), and food consumption frequency form were applied to the individuals. Anthropometric measurements and biochemical findings of individuals were also taken. In accordance with the COVID-19 measures, the questionnaires were applied by telephone or in the form of an online google survey form, in line with the consent of the individuals. SPSS 15.0 statistical package program was used in the Windows environment to evaluate all the obtained information together.

When the data of individuals whose general average age is 55.7±10.52 during the COVID-19 pandemic process are evaluated; 24.4% have good sleep quality and 75.5% have poor sleep quality. According to the sleep quality evaluation results, it was concluded that the biochemical parameters of vitamin D and

magnesium were lower in individuals with poor sleep quality ($p<0.005$). As a result; In individuals diagnosed with diabetes, a larger sample should be studied on the relationship between sleep quality and eating habits.

Keywords: COVID-19, type 2 diabetes, nutrition, sleep quality.

Introduction

Type 2 diabetes (T2DM) is a metabolic disease characterized by relative insulin deficiency in target organs caused by pancreatic β-cell dysfunction and insulin resistance (1). According to the data obtained from the International Diabetes Federation (IDF); In 2019, 463 million individuals worldwide have diabetes and this number will increase to 578 million in 2030; It is estimated that it will increase to 700 million in 2045 (2). T2DM, on the other hand, constitutes 90-95% of all diabetes (3).

Lack of physical activity, unhealthy diet, genetic factors, excessive body weight, advanced age, history of gestational diabetes and family history of diabetes are among the causes of T2DM (4). Medical nutrition therapy has a very important place in the prevention and treatment of diabetes and delaying the complications caused by diabetes (Diabetes Dietitian Association, 2019)

One of the reasons that increase the risk of T2DM is insufficient sleep (5). Sleep is a reversible behavioral state of perceptual detachment and unresponsiveness to the environment. Sleep; It is vital for mental, emotional and physical well-being (6). Sleep quality is; It is defined as the individual feeling fit, fit and ready for a new day after waking up (7).

Negative changes in eating habits and lifestyle threaten human health. Maintaining a healthy diet is very important, especially in a period such as the COVID-19 epidemic when the immune system needs to be strong (8). Having a balanced and healthy diet can help strengthen the human body's immune system, which is important in fighting viruses (9). Nutritional habits, food consumption habits and physical activity information can help create more effective and efficient health policies during the quarantine period (10).

The aim of this study is to evaluate the nutritional habits and sleep quality of patients with T2DM during the COVID-19 pandemic, and to investigate the effect of nutritional habits and sleep quality on biochemical parameters.

Material And Method

Study design and Participants

This research was carried out in the Endocrinology and Metabolism Diseases and Internal Diseases polyclinic of Biruni University Hospital in Istanbul between December 2020 and February 2021.

The population of this study consisted of patients with T2DM who applied to the Biruni University Hospital Endocrinology and Metabolism Diseases and Internal Medicine outpatient clinic. In this research; Individuals between the ages of 35-75 who were diagnosed with T2DM, who agreed to participate in the study, who were not pregnant or lactating, and who received outpatient treatment were included in the study group. Those who were not diagnosed with T2DM, who did not volunteer to participate in the study, who were under the age of 35 or over the age of 75, who were pregnant and lactating, who were diagnosed with cancer or did not receive outpatient treatment, and individuals who did not fill the questionnaire reliably by the researcher were not included in the research group.

Individuals were verbally informed about the content of the research, and consent was obtained from the individuals who agreed to participate in the research, indicating that they approved the voluntary consent form. In order to be able to contact individuals, phone numbers were obtained with the permission of the patients. Afterwards, the surveys were applied by telephone or online google survey form due to Covid-19 measures. Participants were asked to fill in the "Data Collection Form", "Pittsburgh Sleep Quality" scale and "Food Consumption Frequency" forms, which questioned their knowledge about their sociodemographic characteristics, eating habits and the pandemic process. Anthropometric measurements and biochemical findings of individuals were also taken. Anthropometric measurements were taken based on the declaration due to Covid-19 measures. In order to take anthropometric measurements more accurately, visual/video sharing was done to the participants. In the biochemical findings, the test results of 3 (three) months ago were used at most.

In order to carry out this research, the necessary permissions were obtained verbally from Biruni University Hospital in November 2020, then the hospital permission from the chief with wet signature and the T.R. Permission for the study was also obtained from the Ministry of Health.

As a result of the examinations made by Biruni University Non-Interventional Research Ethics Committee, it was decided that this research is ethically appropriate with the decision number 2020/45-11 dated 30/11/2020.

Statistical Analysis

Statistical Package for Social Science Statistics (SPSS) 15.0 package program was used for statistical analysis of all data obtained from individuals participating in the study. Descriptive statistics in the evaluation of study data; given as number (n), percent (%), mean ($\bar{X}$), standard deviation (SD), median (Xort), lower value and upper value. In the comparison of variables, Fisher's Exact or Chi-square (x2) tests were used according to the suitability of the data. Bonferroni correction was made in the complementary post-hoc analyzes applied to identify the sources of the differences. Whether the variables were normally distributed or not was determined by Kolmogorov Smirnov or Shapiro-Wilk test. T-Test or Anova for normally distributed numerical data; "Mann Whitney U" test or "Kruskal Wallis" test was used for numerical data that did not show normal distribution. The relationships between the variables were analyzed by Pearson correlation analysis when the assumption of normality was met and Spearman correlation analysis was used when the assumption of normality was not met. The obtained results were evaluated at the 95% confidence interval and the significance level of $p<0.05$.

Table 1. Descriptive Features

		Female		Male			
		n	**%**	**n**	**%**	**x2**	**p**
Age	**<65**	46	79,3	28	77,8	0.031	0,860
	≥65	12	20,7	8	22,2		
BMI (kg/m²)	**18,5 - 24,9**	12	20,7	2	5,6	4,093	0,129
	25 - 29,9	19	32,8	13	36,1		
	>30	27	46,6	21	58,3		
Education Level	**literate**	5	8,6	-	-	7,504*	0,270
	Primary school	10	17,2	4	11,1		
	Middle School	6	10,3	3	8,3		
	high school	20	34,5	10	27,8		
	Associate degree	3	5,2	3	8,3		
	Bacholare of Science	10	17,2	13	36,1		
	Master of Science	4	6,9	3	8,3		
Marital status	**Single**	15	25,9	4	11,1	2,997	0,083

	Married	43	74,1	32	88,9		
Other Diagnosis	**Yes**	41	70,7	22	61,1	0,922	0,337
	No	17	29,3	14	38,9		
Cigarette	**Yes**	13	22,4	12	33,3	8,500	**0,014**
	No	38	65,5	13	36,1		
	Quit smoking	7	12,1	11	30,6		
Alcohol	**Yes**	9	15,5	11	30,6	2,999	0,083
	No	49	84,5	25	69,4		
COVID-19 Infection	**Yes**	8	13,8	6	16,7	0,145	0,704
	No	50	86,2	30	83,3		
Nutritional Supplement	**Yes**	32	55,2	15	41,7	1,621	0,203
	No	26	44,8	21	58,3		
Total		58	61,7	36	38,3		

*****: *Fisher's Exact Test.*

The descriptive characteristics of the individuals included in the study are given in Table 1. Due to the curfews of individuals during the Covid-19 pandemic process, the age range has been grouped as under 65 years old and 65 years old and over. Individuals who have all been diagnosed with diabetes; 61.7% (n=58) were female and 38.3% (n=36) were male. A significant proportion of individuals (n=48) had a body mass index (BMI) >30 kg/m2, 67% (n=63) had various comorbidities, and 79.8% (n=75) It is seen that his marital status is single. It was determined that 50% (n=47) of the individuals used nutritional supplements, and 14.9% (n=14) had COVID-19 infection. It was determined that there was a statistically significant difference between the genders according to smoking status (p=0.014).

In Table 2., the anthropometric measurements and sleep quality evaluation results of the individuals included in the study; were compared with Mann-Whitney U or T-Test according to normal distribution conditions. With the analyzes made, it was determined that the anthropometric measurements of the individuals' height, waist/hip ratio and waist/height ratio were different according to the sleep quality evaluation results and these differences were statistically significant ($p<0.05$). It is seen that individuals with poor sleep quality have shorter median height, median waist/hip ratio and average waist/height ratio.

Tablo 2. Comparison of Anthropometric Measurements According to Sleep Quality

Anthropometric Measurements	Good Sleep Quality (n=23)	Bad Sleep Quality (n=71)	z/f	p
	x̄ ± SD / Xort (Lower Value - Upper Value)	x̄ ± SD / Xort (Lower Value - Upper Value)		
Height (cm)#	171 (157-185)	165,33 (123-184)	-2,322	**0,02**
Weight (kg)*	87,6±17,76	85,87±19,26	0,395	0,703
BMI (kg/m²)#	29,81(20,20-40,74)	31,39 (22,07-60,15)	-0,778	0,436
Waist circumference *	100,95±13,37	104,18±14,1	0,106	0,337
Hip circumference *	111,04±9,87	113,22±12,18	1,963	0,438
waist/hip #	0,90 (0,74-1,06)	0,92 (0,77-1,15)	-2,062	**0,039**
Waist/height *	0,58±0,06	0,63±0,07	0,472	**0,027**

**: T-Test; #: Mann-Whitney U.*

Sleep quality evaluation results and serum biochemical findings of individuals included in the study; were compared with Mann-Whitney U or T-Test according to normal distribution conditions. According to the results of the analyzes performed, it was determined that the vitamin D and magnesium biochemical parameters were different according to the sleep quality evaluation results and this difference was statistically significant (z=2.002, p=0.045, z=-2.712, p=0.007, respectively). Vitamin D and magnesium levels appear to be lower in individuals with poor sleep.

According to the results of sleep quality assessment and correlation analysis results regarding age, anthropometric measurements and fluid intake, a very weak, but statistically significant, negative relationship was determined between waist/height ratio and sleep quality of individuals diagnosed with diabetes (r=-0.229; p= 0.027)

Tablo 3. Comparison of Biochemical Parameters According to Sleep Quality

	PUKİ					
	Good Sleep Quality		Bad Sleep Quality			
	n	x̄ ± SD / Xort (Lower Value - Upper Value)	n	x̄ ± SD / Xort (Lower Value - Upper Value)	z/f	p
Fasting Glucose #	23	114 (62 - 270)	67	110 (70 - 348)	-0,069	0,945
HbA1c#	20	6,15 (5,1 - 7,7)	64	6,45 (5,1 - 13,5)	-1,619	0,105
Triglyceride #	20	136 (76 - 468)	63	139 (39 - 1264)	-0,282	0,778
HDL-C*	16	54,6±13,79	35	47,8±10,71	0,492	0,486
LDL-C*	21	129,6±40,56	65	117,6±32,01	1,135	0,290
ALT	23	22 (13 - 91)	66	20,5 (9 - 79)	-1,613	0,107
AST	22	19,25 (11 - 52)	63	17 (9 - 50)	-1,428	0,153
Ferritin	16	65,4 (15,7 - 206)	58	52,15 (2,5 - 637,3)	-1,156	0,248
Vitamin D	11	47,7 (13,5 - 108,6)	46	27,3 (8,6 - 71,7)	-2,002	**0,045**
Vitamin B12	16	367,5 (132 - 583)	61	355 (150 - 1323)	-0,628	0,530
TSH	20	1,96 (0,4 - 5,33)	64	1,5 (0,08 - 4,81)	-1,864	0,062
CRP	7	7,9 (2,3 - 27,2)	37	5,2 (0,54 - 88,5)	0,653	0,660
Creatinin	22	0,87 (0,59 - 1,32)	69	0,75 (0,6 - 113,57)	-1,554	0,120
Creatinin Kinase	8	81,5 (25 - 131)	28	57 (29 - 172)	-1,223	0,237
Uric Acid*	17	5,2±1,43	53	4,9±1,14	1,142	0,289
Folic Acid*	8	9±2,99	23	8,4±2,75	0,003	0,955
Calsium	17	9,2 (8,5 - 10,4)	64	9,2 (7,7 - 10,4)	-0,843	0,399
Magnesium	15	2,05 (1,69 - 120,81)	48	1,8 (1,2 - 2,3)	-2,712	**0,007**
Sodium	16	138,5 (132 - 147)	54	139 (130 - 146)	-0,219	0,826
Potasium	16	4,6 (4 - 6)	53	4,4 (4 - 5)	-0,842	0,400

Table 4. The Relationship Between Sleep Quality and Biochemical Parameters

		Sleep Quality
Fasting Glucose	r	-0,044
	p	0,679
HbA1c	r	-0,190
	p	0,083
Triglycerid	r	-0,025
	p	0,822
HDL-C	r	-0,242
	p	0,088
LDL-C	r	-0,135
	p	0,217
ALT	r	0,181
	p	0,090
AST	r	0,105
	p	0,340
Ferritin	r	-0,049
	p	0,676
Vitamine D	r	**0,315***
	p	**0,017**
Vitamine B12	r	-0,127
	p	0,270
TSH	r	**0,217***
	p	**0,048**
CRP	r	-0,032
	p	0,835
Creatinine	r	-0,077

	p	0,466
Creatinine Kinase	r	0,217
	p	0,268
Uric Acid	r	-0,082
	p	0,502
Folic Acid	r	-0,096
	p	0,606
Calsium	r	0,121
	p	0,282
Magnesium	r	0,233
	p	0,066
Sodium	r	0,017
	p	0,888
Potasium	r	0,131
	p	0,284

According to the results of the analysis, a weak positive but statistically significant relationship was determined between vitamin D and sleep quality in individuals diagnosed with diabetes (r=0.315; p=0.017). Similarly, a very weak positive, but statistically significant relationship was found between TSH and sleep quality (r=0.217; p=0.048).

Discussion

The exam in our study; 46.8% of them end the COVID-19 pandemic 47. In one study, quarantine trainings can be grown to be bred to be bred to be bred to be bred for COVID-19 (11). In another study, during the COVID-19 education; for being sure that it is healthy (12). Restrictions on the COVID-19 pandemic process will adversely affect their implementation.

In our study, inspection delivery; 24.4% have good sleep quality and 75.5% have poor sleep quality (Table 2). In our study, the prevalence of poor T2DM was high. In a practice, patient practice was found to belong to poor sleep quality (86%), and sleep quality (13.7%) in the practice with T2DM (2019). Another study found a high prevalence of poor sleep quality among T2DM patients (13). As in our study, the prevalence of sleep quality is high in patients with diffuse T2DM.

In our study, they generally do not have hardware equipment between age and sleep quality ($p>0.05$; Table 2). In a study on the prevalence of good and bad in health, it is present with age (14).

The mean age of the individuals participating in our study was 55.7±10.52 years. Bone density begins to decrease and bone remodeling increases at an average age of 40-50 years. This situation causes a decrease in stature in both genders (Russo et al., 2003). It is thought that the waist/height ratio is higher in the individuals with poor sleep quality in our study due to the fact that the individuals in the study were shorter due to their average age, and their waist circumference was higher due to their high BMI values.

In our study, a statistically significant relationship was determined between waist/hip ratio and sleep quality. It is observed that the waist/hip ratio is higher in individuals with poor sleep quality ($p:0.039$; Table 2). In a study conducted in Turkey, it was determined that there was no significant difference between waist/hip ratio and sleep quality (15). In a study by Topbaş, it was concluded that there was no significant difference between waist/hip ratio and sleep quality. (16). These findings of our study are not compatible with the literature. Considering the BMI values of the individuals participating in our study; 34.0% of them are slightly obese and 51.1% of them are obese. Due to the high BMI values of individuals, it is normal for the waist and hip circumferences to be high. Therefore, it is seen that individuals with poor sleep quality have a higher waist/hip ratio.

It was determined that the frequency of consumption of "Vegetable D" among men in our study made a statistically significant difference on sleep quality (p=0.018; Table 4). Accordingly, it has been determined that reducing the consumption of "Vegetable D" in men diagnosed with diabetes has a significant positive effect on sleep quality. In a study conducted on Japanese men, it was found that there was no significant relationship between the consumption of green and yellow vegetables and sleep quality (17). It is thought that the results of the study differ due to the small sample size in our study.

According to the sleep quality evaluation results in our study, it was determined that the magnesium biochemical parameter was different and this difference was statistically significant. In our study, it is seen that individuals with poor sleep quality have lower magnesium levels (p=0.007; Table 4). In a study conducted in India, it was concluded that there is a statistically positive and significant relationship between sleep quality and serum magnesium level (18).

Magnesium is an essential mineral for the activity of the N-acetyl transferase enzyme, which provides acetylation of serotonin, the precursor of melatonin (19). It also regulates sleep as a stimulant of the neurotransmitter gamma-aminobutyric acid (GABA), which has a calming effect (20). Therefore, individuals with poor sleep quality may have lower magnesium levels.

In our study, according to the sleep quality evaluation results, it was determined that the biochemical parameter of vitamin D was different and this difference was statistically significant. In our study, it was observed that individuals with poor sleep quality had lower vitamin D levels (p=0.045; Table 3). In a study conducted on 871 patients with T2DM in Turkey, it was concluded that the relationship between sleep quality and vitamin D is important (21). These findings of our study are compatible with the literature.

Sleep duration and quality and unhealthy eating habits can be the cause of many chronic diseases. In the treatment of diabetes, it is very important to evaluate and follow up individuals in terms of sleep quality and eating habits. Individuals diagnosed with diabetes; It is recommended to provide nutrition education on healthy nutrition, to create nutrition plans under the follow-up of a dietitian

so that individuals who are not at the ideal weight level can reach the ideal weight level, and to train individuals to increase the sleep quality of individuals.

Conclusion

In line with all these obtained data; In individuals diagnosed with diabetes, a larger sample should be studied on the relationship between sleep quality and eating habits, and as a result, more research on this subject in Turkey is needed in the future.

Conflict Of Interest

None of the authors has any potential financial or commercial conflict of interest associated with this research manuscript.

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