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# Factors affecting sleep quality in patients with type 2 diabetes: a cross-sectional study in Iran

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## Abstract

**Background** Diabetes type 2 is a chronic metabolic disease with major physical and health problems that is on the rise. The aim of this study was to evaluate the factors affecting sleep quality in patients with type 2 diabetes in Iran. This cross-sectional study was conducted on 160 patients with type 2 diabetes referred to the diabetes clinic of Kosar Hospital of Semnan city (Iran) in 2018. The sampling was convenient. The data collection tools were four questionnaires including demographic-clinical variables, Pittsburgh Sleep Quality Index (PSQI) questionnaire, Epworth Sleepiness Scale (ESS), and Beck depression inventory II questionnaire. The data was analyzed by STATA 14 and the crude and adjusted coefficient regression ( $\beta$ ) with a 95% confidence interval (CI) were reported.

**Results** The mean ( $\pm$  S.D) of age was 58.70 ( $\pm$  12.16) years and 60% were female. The multivariate linear regression model showed depression ( $\beta = 0.11$ ; 95% CI 0.07–0.16) and sex ( $\beta = 1.24$ ; 95% CI 0.17–2.30) are the most important predictors of sleep quality in diabetic patients. However, only underlying disease ( $\beta = 1.73$ ; 95% CI 0.33–3.12) was the most important predictors of daily sleep disorder in diabetic patients.

**Conclusions** Depression and sex were the most important predictors of sleep quality in diabetic patients; therefore, it seems necessary to pay attention to these factors in the design of sleep disorder prevention and control programs.

**Keywords** Sleep quality, Type 2 diabetes, PSQI, ESS, Beck's depression score

## Background

Diabetes mellitus, as a silent epidemic, is a chronic metabolic disease with major physical and health problems. According to the report of WHO in 2017, about 462 million people had type 2 diabetes, which is approximately equivalent to 6.28% of the world's population. In other words, its prevalence is equivalent to 6059 cases per 100,000 population. Diabetes is the ninth leading cause of death in the world with more than one million deaths per year. This disease has almost the same sex distribution and the highest incidence is related to 55 years old [1]. Studies have predicted an increase in its prevalence worldwide, and the prevalence of this disease is expected to reach 7079 per 100,000 people by 2030 [1, 2]. In Iran, the fourth national study of risk factors for non-communicable disease in 2011 showed that the national prevalence of diabetes in the adult population of Iran is 11.4%,

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which compared to 2005 indicates a 35% increase in prevalence [3]. The study also estimates that 4.5 million of Iran's adult population will have diabetes in 2011 and predicts that number will reach 9.2 million by 2030 [4].

Like any chronic illness, a person with diabetes has problems that can affect important aspects of their daily lives. This disease leads to numerous socio-family challenges and reduced quality of life of the affected person and has negative effects on the general health and well-being of patients [5–7]. Studies show that diabetics are at higher risk for psychiatric disorders such as depression, overeating, anorexia nervosa, and sleep disorders than the general population [5, 8]. Sleep and rest is an important component of human life and insomnia has a two-way relationship with the prevalence and incidence of diabetes, and sometimes insomnia can be due to diabetes or the risk factor for diabetes [9, 10]. A number of studies have shown that increasing or decreasing the duration of nighttime sleep is associated with an increased prevalence and incidence of diabetes or inadequate blood sugar control in diabetics [10–12]. Most studies in this field have studied the effect of sleep on blood sugar levels, while the opposite can also be true. In other words, diabetes due to enuresis, neuropathic pain, depression, and other pathologies that patients with it usually experience causes a disturbance in the quantity or quality of sleep in these people [13].

Given that the increasing prevalence of type 2 diabetes in developing countries such as Iran and also the importance of optimal control of blood sugar in diabetics by adjusting lifestyle, the importance of attention to sleep hygiene and psychological status in people with diabetes as an optimal prevention and treatment of diabetic patients is proposed. Therefore, this cross-sectional study was designed to evaluate the factors affecting sleep quality in patients with type 2 diabetes referred to the diabetes clinic of Kosar Hospital of Semnan city (Iran) in 2018.

## Methods

### Study design and subjects

This cross-sectional study was designed to determine the factors affecting sleep quality in patients with type 2 diabetes referred to the diabetes clinic of Kosar Hospital of Semnan city (Iran) in 2018. The study was conducted as a census, and all patients with type 2 diabetes referred to this clinic in 2018 were examined who were 160 patients. Inclusion criteria consisted of age of 18 years and older, outpatients, and consent to participate in the study. Exclusion criteria consisted of having any kind of illness or mental disorder, lack of interest in participating in the project, the existence of neurological defects (acquired or congenital) having craniofacial or deformities disorders, and consumption of psychotropic drugs

and alcohol during the study. It should be mentioned that we extracted the information related to psychiatric diseases, other medical disorders, or medical and complications of diabetes from the files of these patients, because the patients who have visited this diabetes clinic have a medical record and undergo routine and periodical care.

### Data collection

The data collection tools were four questionnaires including demographic-clinical variables, Pittsburgh Sleep Quality Index (PSQI) questionnaire, Epworth Sleepiness Scale (ESS), and Beck depression standard questionnaire which have already been validated and reliable in various studies in Iran. The PSQI questionnaire consists of 7 Sects. (1- subjective sleep quality; 2- sleep latency; 3- sleep duration; 4- habitual sleep efficiency; 5- sleep disturbances; 6- use of sleeping medication; 7- daytime dysfunction) and 19 questions. Each question is scored on a Likert scale from 0 to 3 (0=no sleep problem; 1=moderate sleep problem; 2=serious sleep problem; and 3=very serious sleep problem). The ESS score (the sum of 8 item scores, 0–3) can range from 0 to 24 which 0 to 9=normal range and >9=abnormal range of sleepiness. The Beck depression questionnaire also includes 21 questions that are scored on a Likert scale from 0 to 3. Its total score is in the range of 0 to 63. A score less than 10 as non-depressive, 10 to 16 as mild mood disturbance, 17 to 30 as moderate depression, 31 to 40 as severe depression, and more than 41 as extreme depression will be considered. The level of FBS, HbA1c, and the type of drug used (Metformin, Glibenclamide, and insulin was extracted from the patients' medical records. Other information was collected through patient interviews.

### Statistical analysis

Data were analyzed by STATA14. Mean, standard deviation, and frequency (%) were used for the descriptive analysis of data. Univariate and multivariate linear regression analyses were employed to evaluate the factors affecting sleep quality in patients with type 2 diabetes and the crude and adjusted coefficient regression ( $\beta$ ) with a 95% confidence interval (CI) were reported.

### Ethics statement

This study was approved by the Deputy of Research and Ethics Committee of Semnan University of Medical Sciences (Iran).

### Results

This cross-sectional study was on 160 patients with type 2 diabetes referred to the diabetes clinic of Kosar Hospital of Semnan city (Iran) in 2018. Table 1 shows the demographic and clinical characteristics of patients

**Table 1** Demographic and clinical characteristics of patients under study

Variables	Number	Mean	S.D <sup>a</sup>	Minimum	Maximum
Age (year)	160	58.70	12.16	18	93
Weight (kg)	160	75.16	13.94	41	120
Height (cm)	160	163.07	10.52	126	190
BMI (kg/m <sup>2</sup> )	160	23.04	3.96	12.88	37.17
FBS (mg/dl)	160	152.25	55.44	57	360
HbA1c (mg/dl)	160	8.31	1.64	4.20	14.80
Duration of diabetes (year)	160	9.19	7.46	1	35
<b>Variables</b>	Number	%			
<b>Sex</b>	Female	96	60		
	Male	64	40		
<b>Education</b>	Non-academic	124	77.5		
	Academic	36	22.5		
<b>Marital status</b>	Married	133	83.1		
	Single	27	16.9		
<b>Underlying diseases</b>	No	67	41.9		
	Yes	93	58.1		
<b>Complications</b>	No	101	63.1		
	Yes	59	36.9		
<b>Type of medicine taken</b>	Metformin	51	31.9		
	Metformin + Glibenclamide	38	23.8		
	Insulin	71	44.4		

<sup>a</sup> S.D standard deviation

under study. As can be seen, the mean ( $\pm$ ) of age, BMI, FBS, HbA1c, and duration of diabetes in the patients were 58.70 ( $\pm$  12.16) years, 23.04 ( $\pm$  3.96) kg/m<sup>2</sup>, 152.25 ( $\pm$  55.44) mg/dl, 8.31 ( $\pm$  1.64) mg/dl, and 9.19 ( $\pm$  7.46) year, respectively. Sixty percent were female, and the rest were male. Also, 83.1% were married, 58.1% had an underlying disease, and 63.1% reported one complication of diabetes. The highest drug consumption with 44.4% was related to insulin (Table 1).

Table 2 shows the mean, S.D., minimum. and maximum questionnaires under study with their subscales. The mean ( $\pm$  S.D) of the Global PSQI score, ESS, and Beck's Depression Inventory were 10.59 ( $\pm$  3.55), 7.86 ( $\pm$  4.33), and 17.94 ( $\pm$  11.38), respectively. Also in the PSQI questionnaire, the highest and lowest scores were related to sleep duration and use of sleeping medication scales with 2.42 ( $\pm$  0.67) and 0.57 ( $\pm$  1.10), respectively.

**Table 2** Mean, S.D, Min, and Max questionnaires under study with its subscales

Questionnaires	Number	Mean	S.D <sup>a</sup>	Minimum	Maximum
Pittsburgh Sleep Quality Index (PSQI)					
I Subjective sleep quality	160	1.61	1.03	0	3
II Sleep latency	160	1.59	1.29	0	3
III Sleep duration	160	2.42	0.67	0	3
IV Habitual sleep efficiency	160	2.14	1.08	0	3
V Sleep disturbances	160	1.52	0.66	0	3
VI Use of sleeping medication	160	0.57	1.10	0	3
VII Daytime dysfunction	160	0.72	0.66	0	3
Global PSQI score	160	10.59	3.55	3	18
Epworth sleep scale	160	7.86	4.33	0	20
Beck's depression inventory	160	17.94	11.38	0	61

<sup>a</sup> standard deviation (S.D)

Table 3 shows the frequency distribution (%) of depressive and sleep disorders in the studied patients. According to Beck's Depression Inventory, 75.6% of diabetics had some degree of depressive disorder. Also, according to the ESS questionnaire, 26.2% of patients had daily sleep disorders. In addition, the survey showed that the prevalence of moderate, serious, and very serious sleep disorders was 21.9, 61.3, and 16.9%, respectively, and in other words, all patients under study had sleep disorders.

Table 4 shows the factors affecting sleep quality (Pittsburgh Sleep Quality Index) of patients with type 2 diabetes by univariate and multivariate linear regression models. The results of the univariate linear regression model showed that age, FBS, HbA1c, Beck's Depression score, sex, education, and marital status were the most important predictors of sleep disorders in diabetic patients ( $P$  value  $\leq 0.20$ ). Then, the variables with a  $P$  value  $\leq 0.20$  were introduced to the multivariate linear regression model. As can be seen, Beck's depression score ( $\beta=0.11$ ; 95% CI 0.07–0.16) and sex ( $\beta=1.24$ ; 95% CI 0.17–2.30) were the most important predictors of sleep disorders in diabetic patients ( $P$  value  $< 0.05$ ), so that for every 1 unit increase in the mean of Beck's depression score, the sleep disorders in diabetic patients are increased an average of 0.11 units. In addition, the sleep disorders in diabetic women are 1.24 units higher than in diabetic men (Table 4).

Table 5 shows the factors affecting daily sleep disorder (Epworth Sleep scale) of patients with type 2 diabetes by univariate and multivariate linear regression models. As can be seen, after adjustment, only underlying diseases ( $\beta=1.73$ ; 95% CI 0.33–3.12) were the most important predictors of daily sleep disorder in diabetic patients ( $P$

value  $< 0.05$ ), so that the daily sleep disorder in diabetic patients with the underlying disease is 1.73 units higher than diabetic patients without the underlying disease (Table 5).

## Discussion

Poor sleep quality, sleep disorders, especially insomnia, obstructive sleep apnea, and restless legs syndrome are some of the most common sleep problems in people with type 2 diabetes [14]. Proper sleep quality in diabetic patients can play an important role in controlling blood sugar and improving their quality of life [15]. Therefore, the aim of this study was to evaluate the factors affecting sleep quality in patients with type 2 diabetes referred to the diabetes clinic of Kosar Hospital of Semnan city (Iran) in 2018. The results of this study showed that the mean ( $\pm$ ) of age was 58.70 ( $\pm 12.16$ ) years and 60% were female. The results of the univariate linear regression model showed that age, FBS, HbA1c, depression, sex, education, and marital status are the most important predictors of sleep disorders in diabetic patients ( $P$  value  $\leq 0.20$ ). However, after adjusting for the confounding variables by the multivariate linear regression model, depression ( $\beta=0.11$ ; 95% CI 0.07–0.16), and sex ( $\beta=1.24$ ; 95% CI 0.17–2.30) were the most important predictors of sleep disorders in diabetic patients ( $P$  value  $< 0.05$ ). In addition, the results of the multivariate linear regression model showed that only underlying disease ( $\beta=1.73$ ; 95% CI 0.33–3.12) is the most important predictors of daily sleep disorder in diabetic patients ( $P$  value  $< 0.05$ ).

In a study conducted by Barakat et al. to evaluate sleep quality and its related factors in patients with type 2 diabetes, the prevalence of poor sleep quality in the studied

**Table 3** Frequency distribution (%) of depressive and sleep disorders in the studied patients

Questionnaires		Number	%
Beck's depression inventory	Normal	39	24.4
	Mild mood disturbance	43	26.9
	Moderate depression	55	34.4
	Severe depression	15	9.4
	Extreme depression	8	5.0
	<b>Total</b>	160	100
Epworth sleep scale	Normal	118	73.8
	Abnormal	42	26.2
	Total	160	100
Pittsburgh Sleep Quality Index (PSQI)	No sleep problem	0	0
	Moderate sleep problem	35	21.9
	Serious sleep problem:	98	61.3
	Very serious sleep problem	27	16.9
	Total	160	100

**Table 4** The factors affecting sleep quality (Pittsburgh Sleep Quality Index) of patients with type 2 diabetes by univariate and multivariate linear regression

Variable	Univariate linear regression		Multivariate linear regression		
	$\beta$ (95% CI)	P value	$\beta$ (95% CI)	P value	
Age (year)	0.04 (− 0.004 to 0.08)	0.075	0.03 (− 0.007 to 0.07)	0.107	
BMI (kg/m <sup>2</sup> )	0.05 (− 0.09 to 0.19)	0.478	-	-	
FBS (mg/dl)	0.01 (0.003 to 0.02)	0.042	0.006 (− 0.003 to 0.01)	0.218	
HbA1c (mg/dl)	0.34 (0.01 to 0.68)	0.043	0.16 (− 0.18 to 0.49)	0.356	
Duration of diabetes (year)	0.02 (− 0.05 to 0.09)	0.573	-	-	
Beck's depression score	0.13 (0.08 to 0.17)	<0.001	0.11 (0.07 to 0.16)	<0.001	
Sex	Male	Reference	-	-	
	Female	1.51 (0.4 to 2.61)	0.008	1.24 (0.17 to 2.30)	0.023
Education	Non_academic	Reference	-	-	
	Academic	− 1.01 (− 2.33 to 0.30)	0.133	0.12 (− 1.12 to 1.37)	0.849
Marital status	Married	Reference	-	-	
	Single	0.98 (− 0.49 to 2.45)	0.192	0.50 (− 0.87 to 1.87)	0.476
Underlying diseases	No	Reference	-	-	
	Yes	0.58 (− 0.54 to 1.70)	0.305	-	-
Complications	No	Reference	-	-	
	Yes	0.32 (− 0.83 to 1.47)	0.582	-	-
Type of medicine taken	Metformin	Reference	-	-	
	Metformin + Glibenclamide	0.11 (− 1.38 to 1.61)	0.882	0.79 (− 0.60 to 2.18)	0.263
	Insulin	0.88 (− 0.40 to 2.16)	0.178	0.84 (− 0.33 to 2.02)	0.158

CI confidence interval

$\beta$  coefficient of regression

patients was 81% and the variables of HbA1c, female gender (OR 2.88), smoking, unemployment, and insulin use were the most important predictors of poor sleep quality in diabetic patients [16]. The result of this study and a number of other studies [17, 18] were consistent with the results of our study in terms of gender variable because in our study, female gender ( $\beta = 1.24$ ; 95% CI 0.17–2.30) was an important risk factor and predictor of sleep quality in diabetic patients. This difference in sleep quality between men and women may be due to BMI, body fat percentage, and hormonal differences.

In the present study, there was a relationship between HbA1c and FBS and sleep quality in diabetic patients in univariate mode; however, after controlling for confounding variables, the relationship between these two factors and sleep quality was not statistically significant which this finding was not consistent with similar studies in this field [16, 19–21]. Identifying and understanding the mechanisms by which abnormal sleep disrupts the blood sugar metabolism cycle and consequently lacks proper control of diabetes can help diagnose the effect of these disorders on high blood sugar. Previous studies have shown that decreased glucose tolerance overnight and increased peripheral tissue resistance to insulin lead to diabetic conditions, which can be partly due to a

decrease in insulin sensitivity overnight and decreased response of insulin secretion to increased blood glucose [19, 22, 23]. On the other hand, some studies have suggested that irregular sleep at night is effective in increasing the function of cortisol and growth hormones, which also affect the metabolic cycle and reduce glucose tolerance and thus induce diabetes [24].

In our study, depression ( $\beta = 0.11$ ; 95% CI 0.07–0.16) was the most important predictors of sleep disorders in diabetic patients which is in line with studies conducted in this field. In general, there is a two-way relationship between depression and sleep disorders, so that mood disorders can lead to insomnia and ultimately increase the risk of depression. Depression can lead to insomnia in most people with chronic illnesses who are constantly exposed to a variety of stressors. The opposite is also true, sleep disorders can lead to depression, memory impairment, difficulty concentrating, anxiety, fatigue, irritability, and poor quality of life [25–28].

This study has a number of limitations that need to be noted. First, the present research is a cross-sectional study which was performed on a group of patients with type 2 diabetes and lacking a control group, while studies such as a case–control study with two groups with equal sample size can increase the statistical efficiency. Second,

**Table 5** The factors affecting sleep quality (Epworth Sleep scale) of patients with type 2 diabetes by univariate and multivariate linear regression

Variable	Univariate linear regression		Multivariate linear regression	
	$\beta$ (95% CI)	P value	$\beta$ (95% CI)	P value
Age (year)	0.05 (− 0.007 to 0.11)	0.047	0.03 (− 0.03 to 0.09)	0.344
BMI (kg/m <sup>2</sup> )	0.09 (− 0.07 to 0.27)	0.270	-	-
FBS (mg/dl)	− 0.005 (− 0.01 to 0.006)	0.336	-	-
HbA1c (mg/dl)	− 0.16 (− 0.58 to 0.25)	0.434	-	-
Duration of diabetes (year)	− 0.005 (− 0.09 to 0.08)	0.903	-	-
Beck’s depression score	0.04 (− 0.02 to 0.09)	0.198	0.02 (− 0.03 to 0.08)	0.424
Sex	Male	Reference	-	-
	Female	0.50 (− 0.88 to 1.88)	0.477	-
Education	Non-academic	Reference	-	-
	Academic	− 0.18 (− 1.81 to 1.44)	0.826	-
Marital status	Married	Reference	-	-
	Single	0.70 (− 1.10 to 2.51)	0.446	-
Underlying diseases	No	Reference	-	1.73 (0.33 to 3.12)
	Yes	2.10 (0.76 to 3.43)	0.002	-
Complications	No	Reference	-	-
	Yes	1.42 (0.03 to 2.81)	0.044	0.71 (− 0.75 to 2.18)
Type of medicine taken	Metformin	Reference	-	-
	Metformin + Glibenclamide	− 0.24 (− 2.08 to 1.60)	0.799	-
	Insulin	0.34 (− 1.23 to 1.93)	0.664	-

CI confidence interval

$\beta$  coefficient of regression

in a cross-sectional study, it is difficult to examine the causal relationship because the two variables are examined simultaneously and is unclear which one occurred before the other; in other words, the assumption of temporality is not considered, and therefore, we need prospective cohort studies to overcome this limitation [29, 30].

**Conclusions**

The present study showed that depression and sex are the most important predictors of sleep disorders in diabetic patients; therefore, in designing and implementing sleep disorder prevention and control programs, it seems necessary to pay attention to these factors. On the other hand, due to the low quality of sleep in diabetic patients, teaching the patient the necessary measures such as relaxation and muscle relaxation techniques and setting activity hours and sleep and techniques for deviation of thought to control or eliminate the effective factors on the sleep disorder are suggested.

**Abbreviations**

PSQI Pittsburgh Sleep Quality Index questionnaire  
 ESS Epworth Sleepiness Scale

S.D Standard deviation  
 CI Confidence interval

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**Authors’ contributions**

Conceptualization, N.SK and E.G.; Methodology, S.D. and E.G.; Software, E.G. and K.M.; Validation, N.SK. and E.G. and S.D.; Investigation, S.D., N.SK., and E.G.; Data curation, N.SK. and E.G.; Writing—original draft preparation; E.G. and K.M.; Writing—review & editing; N.SK. and E.G.; Visualization, F. S.D., N.SK., and E.G.; Supervision, E.G.; Project administration, E.G.; Funding acquisition, E.G. The authors have read and agreed to the published version of the final manuscript.

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**Availability of data and materials**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

**Declarations**

**Ethics approval and consent to participate**

This study was performed according to the principles expressed in the Declaration of Helsinki and was approved by the Deputy of Research and Ethics

Committee of Semnan University of Medical Sciences. All the participants have accepted and signed the informed consent.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.

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