



# Relationship between sleep quality and depression in people with type 2 diabetes

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## Abstract

**Background** sleep quality disorder is both a risk factor for diabetics and a symptom of depression. This study aimed to determine the relationship between sleep quality and depression in people with type 2 diabetes in Delijan city in 2022.

**Methods** The present study was a descriptive-analytical study conducted on 245 people with Type 2 Diabetes Mellitus (T2DM). The data were collected from health centers and homes, diabetes clinics in the city of Delijan. The sampling method in this study was Convenience. Inclusion criteria include people over 30 years old, people with a history of diabetes for more than six months and people with no known mental disorders. Data collection tools included the Pittsburgh Sleep Quality Index (PSQI), the Beck questionnaire, clinical information about diabetes (FBS, %HbA1c level and duration of diabetes), and a checklist of demographic information. SPSS 23 software was used for data analysis. Data were analyzed using independent t-tests, Chi-square, ANOVA and logistic regression. A significance level of  $P < 0.05$  was considered significant.

**Results** The mean (SD) age of the participants was 57.58 (10.58) years. Regarding gender, 162 subjects (66.1%) were female. A statistically significant relationship was observed between the quality of sleep in people with type 2 diabetes with gender, education, Family history T2DM, age, and between depression with gender and FBG. a statistically significant relationship was observed between sleep quality and depression. Also, according to the logistic regression, sleep quality (dependent variable) showed a significant relationship with depression, age, sex, and education.

**Conclusion** According to the results, there is a significant relationship between sleep quality and depression In people with T2DM, so it can be used in periodic care of diabetic people to screen for depression, which could improve their sleep quality to some extent.

**Keywords** Sleep quality · Depression · Type 2 Diabetes

## Introduction

Diabetes often poses a major threat to human health. There is a close relationship between diabetes as a health risk factor and people's modern lifestyle [1]. Every year, 20% of diabetics die as a result of the disease, and the trend is rising [2]. In 2017, it was estimated that 451 million people aged 18–99 years had diabetes, and this number is expected to reach 693 million by 2045 [3]. There are currently almost five to seven million diabetics in Iran [4]. During sleep, the body releases many important hormones to regulate metabolic and endocrine functions. The main role of sleep is to restore balance to the entire body, including the central nervous system, and it is a daily need [5]. sleep quality disorder is an important risk factor for Type 2 Diabetes Mellitus (T2DM) [6]. Sleep disturbances are common in patients with T2DM, and a previous study reported a high

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prevalence of sleep disturbances in patients with T2DM [7–9]. Sleep plays an important role in controlling blood sugar levels, and lack of sleep has been linked to diabetes predictors such as insulin resistance and decreased insulin response to glucose [10–12]. In patients with T2 diabetes, it has been reported that 39.4–55% suffer from short sleep and poor sleep quality [9]. Depression is one of the most common comorbidities in patients with diabetes [13]. Both diabetes and depression are serious and long-lasting, affecting quality of life and causing functional disability and reducing life expectancy. People who have diabetes are likely to develop symptoms of depression, and people with depression can also develop diabetes [14]. It has also been shown that depression is associated with an increased risk of morbidity and mortality in people with diabetes, and that depression may reduce adherence to glucose-lowering treatments [15]. Depression in these patients can significantly affect the prognosis of diabetes, and some studies have shown that failure to diagnose and treat depression worsens patients' prognosis. Depression not only causes psychological and social complications in patients with diabetes, but can also be a risk factor for poor metabolic control in these patients. Some researchers have found a weak to moderate association between depression and inadequate glycemic control in patients with diabetes, with the prevalence of depression in diabetics being around 60%, of whom 40.6% have moderate to severe depression [16, 17]. Given the high prevalence of sleep quality disorder and depression in diabetics and the many complications these disorders bring to diabetics, as well as the few studies that have been conducted in this area, this study aimed to determine the association between sleep quality disorder and the severity of the Studying depression in diabetics.

## Methods and materials

### Participants

This descriptive-analytical study was conducted in the city of Delijan in the province of Markazi. The data was collected from April to June 2022 at cross section of the year. The sampling method was convenient, allowing people with T2DM to be treated regularly at health treatment centers, health centers and diabetes clinics in Delijan city after obtaining consent were included in the study. The sample size based on Hamburger et al.'s study, the mean and standard deviation of depression in diabetic patients are 4.14 and 4.02 respectively, the mean and standard deviation of sleep disorder in diabetic patients are 4.73 and 2.30 respectively, the significance level is  $\alpha=0.05$   $Z_{1-\alpha/2}=1.96$  and the power of the  $Z_{1-\beta}=0.8$  test and the minimum sample size required

to conduct the study was estimated to be 191 people To increase the external validity of the study, we distributed the questionnaire among 264 people, of which 245 people were They answered the questionnaire [18]. Ultimately, 245 people took part in the study. Inclusion criteria were people over 30 years of age with health records in health centers, people with a history of diabetes for more than six months (T2DM was defined by any of the following criteria: FBS level  $\geq 126$  mg/dL and %HbA1c level  $\geq 7$ .) [7]. Exclusion criteria were women with gestational diabetes, type 1 diabetics and people who did not complete the questionnaire completely. After participating in the study, participants completed questionnaires on the Pittsburgh Sleep Quality Index (PSQI), Beck's depression, clinical information about the disease (fasting blood glucose (FBG) score, %HbA1c, and duration of diabetes), and a checklist of demographic information. For those who did not have sufficient literacy skills to complete the questionnaires, the requested information was collected through interviews. There is a possibility of fatigue caused by filling out the questionnaires and not completing the questionnaires carefully. which we created randomly for the people participating in the study alternately in the order of the questionnaires, for example, for some, first the sleep disorder questionnaire, then the severity of depression; For some, first the severity of depression followed by sleep disorder. Also, in order to avoid information bias among people (especially the elderly and illiterate people) to express the amount of fasting blood sugar and hemoglobin A1C, we obtain their information through their last tests during the last month which is registered in the system. In order to deal with the missing data, it was handled in such a way that the information of the person who was closest to the person whose information was lost was used. For example, for a 50-year-old man with FBS: 120 and HA1c=6.5, we tried to use similar personal information for missing data.

### Confounders

Also, in order to control the confounding variable, there were people who have an uncontrolled disease and people known to be mentally ill (polar disorders, substance abuse, etc.) The rest of the confounders are removed through logistic regression of the adjusted results.

### Measurement tools

#### The Pittsburgh Sleep Quality Index (PSQI)

Sleep quality was measured using the PSQI. The PSQI assesses sleep quality over the last month and includes 7 scales: 1- understanding of a person's sleep quality (sleep

quality), 2- delay in falling asleep (sleep latency), 3- actual sleep duration (sleep duration), 4- sleep efficacy, 5- sleep disturbances, 6- sleep medication, 7- time day dysfunction. Each of the scales has 0 to 3 points. The total PSQI score (range 0 to 21) results from the sum of the scale values. A PSQI total score of 5 indicates poor sleep quality, higher scores indicate poorer sleep quality [19, 20]. The validity of the Persian version of the questionnaire in Iran was 0.85 and the Cronbach's alpha coefficient measuring the reliability of the questionnaire for all dimensions was higher than 0.77 [21].

### Beck depression questionnaire

This questionnaire was compiled by Beck in 1961. This questionnaire contains 21 questions, each question contains four options with a rating range from 0 to 3 and the total score ranges from 0 to 63. In this questionnaire a score from 0 to 9 is given no disorder, 10–18 mild depression, 19–29 moderate depression and 30–63 severe depression. The one-week retest reliability is 0.93 and the internal consistency by Cronbach's alpha is 0.91. Also, construct validity was examined using the convergent validity calculation method to calculate the correlation coefficient of the scores obtained from the second edition of the Beck depression version, which showed a correlation of 0.873 [22, 23].

### Statistical analysis

Descriptive statistics were used to describe the data by presenting center and indices of dispersion for quantitative variables, and frequency and percentage for qualitative

**Table 1** Demographic characteristics of people participating in the study (N = 245)

P-value	Variable	N	%
Gender	Male	83	33.9
	Female	162	66.1
Education	Illiterate	93	38.0
	Primary	84	34.3
	Diploma	50	20.4
	Bachelor $\geq$	18	7.3
Marital status	Single	17	6.9
	Married	201	82.1
	Divorced	27	11.0
Family history T2DM	Yes	172	70.2
	No	73	29.8
Comorbidity	Yes	153	62.4
	No	92	37.6
Residence	Urban	170	69.4
	Rural	75	30.2
%HbA1c	<7	172	70.2
	>7	73	29.8

N:number, T2DM: Type 2 Diabetes Mellitus

variables. After measuring the normality of the data using the Kolmogorov-Smirnov test and normality of data from parametric tests, independent t-tests, Chi-square, analysis of variance (ANOVA), Pearson's correlation, and logistic regression were used. All statistical tests were performed using SPSS version 23 software and  $p < 0.05$  was considered a significant value.

## Results

The mean (SD) age of the study participants was 58.57 (10.58) years. Of the 245 participants in this study, 162 (66.1%) were women; 93 people (38%) were illiterate; 201 people (82.1%) were married; 172 people (70.2%) had a positive family history T2DM; 153 people (62.4%) suffered from another chronic disease in addition to diabetes; 170 people (69.4%) lived in rural areas and 172 people had an %HbA1c value below 6.9%. The mean (SD) fasting blood glucose was 150.33 (48.27) mg/dL. In addition, the average duration of diabetes in humans was 7.8 years (Table 1).

Among the diabetics who took part in the study, 94 people did not have depression and 113 people had depression. Of the people with depression, 36 had mild depression, 56 had moderate depression, and 21 had severe depression. Also, 106 participants had good sleep quality and 139 people had poor sleep quality. Among demographic variables, gender ( $P < 0.04$ ), education ( $P < 0.04$ ), Family history T2DM ( $P < 0.01$ ), and age ( $P < 0.03$ ) were found to have a statistically significant association with sleep quality have. People who could not read and write adequately and people with a family history T2DM had poor sleep quality. However, no statistically significant association was observed between other demographic variables and sleep quality (Table 2).

According to Table 3, a statistically significant relationship was observed between gender ( $P < 0.04$ ) and FBG value ( $P < 0.02$ ) with depression, but no statistically significant relationship was observed between other demographic variables and depression.

In this study, the relationship between sleep quality and depression was investigated, and the mean depression score in people with poor sleep quality was higher than in people with good sleep quality ( $P < 0.01$ ) (Table 4).

Finally, logistic regression was used to predict sleep quality variable according to depression variable and demographic variables. According to the Table 5, depression variables ( $p = 0.01$ , OR = 1.13, 95% CI 1.08–1.25), age ( $p = 0.00$ , OR = 1.253, 95% CI 1.02–1.48), gender ( $p = 0.04$ , OR = 0.50), 95% CI 0.26–0.96), diploma education compared to illiterates ( $p = 0.00$ , OR = 6.45, 95% CI 1.71–24.24), primary education compared to illiterates ( $p = 0.03$ , OR = 4.34, 95% CI 1.08–17.38) showed a statistically

**Table 2** Relationship between sleep quality disorder and demographic variables in people with T2DM (N = 245)

P-value	Variable	Good quality, N = 106	Poor quality, N = 139	P value
Gender <sup>A</sup>	Male	43(%40.6)	40(%28.8)	0.04
	Female	63(%59.4)	99(%71.2)	
Education <sup>A</sup>	Illiterate	34(%32.1)	59(%42.4)	0.04
	Primary	44(%41.5)	40(%28.8)	
	Diploma	24(%22.6)	26(%18.7)	
	Bachelor $\geq$	4(%3.8)	14(%10.1)	
Marital status <sup>A</sup>	Single	9(%8.5)	8(%5.8)	0.41
	Married	88(%83)	113(%81.3)	
	Divorced	9(%8.5)	18(%12.9)	
Family history T2DM <sup>A</sup>	Yes	66(%62.3)	106(%76.3)	0.01
	No	40(%37.7)	33(%23.7)	
Comorbidity <sup>A</sup>	Yes	65(%61.3)	88(%63.3)	0.75
	No	41(%38.7)	51(%36.7)	
Residence <sup>A</sup>	Urban	73(%68.9)	98(%70.5)	0.55
	Rural	33(%31.1)	41(%29.5)	
%HbA1c <sup>A</sup>	< 7	78(%73.6)	94(%67.6)	0.32
	> 7	28(%26.4)	45(%32.4)	
Age <sup>*</sup>		Mean(SD)	Mean(SD)	0.03
FBG <sup>*</sup>		56.95(10.79)	59.81(10.29)	
Disease duration T2DM <sup>*</sup>		148.74(42.98)	151.54(52.07)	0.65
		8.14(6.61)	7.80(5.50)	0.52

N: number, T2DM: Type 2 Diabetes Mellitus

A: Chi-square test, \*: independent t-tests

**Table 3** Relationship between depression and demographic variables in people with T2DM (N = 245)

P-value	Variable	N	Mean score (SD)	P value
Gender <sup>*</sup>	Male	83	14.29 (12.12)	0.03
	Female	162	17.96 (13.35)	
Education <sup>¥</sup>	Illiterate	93	14.13(9.61)	0.42
	Primary	84	16.65(14.05)	
	Diploma	50	15.32(14.25)	
	Bachelor $\geq$	18	18.16(14.92)	
Marital status <sup>¥</sup>	Single	4	20.25(18.94)	0.40
	Married	214	15.57(12.74)	
	Divorced	27	14.55(11.23)	
Family history T2DM <sup>*</sup>	Yes	172	15.22(12.08)	0.55
	No	73	16.27(13.96)	
Comorbidity <sup>*</sup>	Yes	153	15.87(12.84)	0.59
	No	92	14.97(12.36)	
Residence <sup>*</sup>	Urban	171	15.45(13.39)	0.83
	Rural	74	15.74(10.80)	
%HbA1c <sup>*</sup>	< 7	172	15.04(12.64)	0.35
	> 7	73	16.69(12.68)	
FBG <sup>€</sup>			Correlation	0.02
		245	0.14	
Disease duration T2DM <sup>€</sup>		245	-0.03	0.56
Age <sup>€</sup>		245	0.070	0.24

N: number, T2DM: Type 2 Diabetes Mellitus

\*: independent t-tests, ¥: analysis of variance (ANOVA), €: Pearson's correlation

**Table 4** Relationship between depression and sleep quality disorder in patients with T2DM (N=245)

Sleep quality*	N	Mean score (SD)	P value
Poor	139	17.81(15.45)	0.01
Good	106	13.80(9.71)	

\*: independent t-tests

significant relationship with sleep quality in this way that for one unit increase in depression and age, the chance of low sleep quality increases by 1.13 and 1.25 times, respectively. The chance of low sleep quality decrease in men than women ( $p=0.04$ ,  $OR=0.50$ , 95% CI 0.262–0.968). Also, the chance of low sleep quality in people with a diploma education is 6.45 times higher than that of illiterate people, and the chance of low sleep quality in people with elementary education is 4.34 times higher than that of illiterate people (Table 5).

## Discussion

In the present study, more than half (54.5%) of people with T2DM had depression of varying degrees (severe/moderate/mild). In the study from Ghana (2018), Australia (2017), Nepal (2019) and Mexico (2018), the prevalence of depression in people with T2DM was found to be 31.3%, 20%, 22.7% and 30%, respectively. As reasons for the difference between the present study and the studies mentioned above, we can cite the sociocultural and racial differences, as well as the difference in the sample size and the instruments used to measure the degree of depression [24–27]. In this study, it was shown that the prevalence of poor sleep quality in

people with T2DM is 56.7%. The current study with studies from the USA (2019), Taiwan (2021), Pakistan (2020) and a systematic review study (2019) found a prevalence of poor sleep quality in people with T2DM of 53%, 56%, 57%, 54.5%, respectively and it was consistent [28, 29]. Some mechanisms have been proposed to explain this high prevalence. Excessive activation of the sympathetic nervous system, reduction in brain glucose consumption, increase in night growth hormone and cortisol levels due to increased activity of the hypothalamic-pituitary-adrenal axis generally alters glucose metabolism and causes insulin resistance in healthy individuals [30]. In the present study, a statistically significant relationship was observed between gender and low sleep quality, in that the probability of sleep quality disorder was lower in men than in women. The present study was consistent with the study conducted in Jordan (2019), in which women reported poorer sleep quality than men [31]. To justify the results obtained, it can be pointed out that factors such as puberty, the menstrual cycle, pregnancy and menopause in women produce specific hormonal and physical changes in women that aggravate the deterioration in sleep quality or sleep quality disorder in women [32]. The present study was able to show that there is a statistically significant connection between age and poor sleep quality. Also, based on the logistic regression test, the odds of having a sleep quality disorder increase by 1.25 with age. The present study was consistent with studies conducted in Saudi Arabia (2018), Japan (2018) and Ethiopia (2020) [33–35]. However, this was not consistent with studies conducted in Singapore (2018) and Iran (2019) [36, 37]. To justify the results obtained, it can be pointed out that sleep quality disorder is more common in people of an

**Table 5** Relationship between sleep quality disorder and depression and demographic variables using logistic regression model (N=245)

Variables	B	p-Value	OR	95% CI		
				Lower	Upper	
Depression	0.041	0.012	1.131	1.087	1.256	
Age	0.058	0.005	1.253	1.022	1.486	
Gender(Men = 1 ,woman = 0)	-0.686	0.040	0.504	0.262	0.968	
Education	Illiterate	-	-	-	-	
	Primary	1.470	0.038	4.348	1.087	17.384
	Diploma	1.864	0.006	6.450	1.716	24.243
	Bachelor $\geq$	1.270	0.061	3.561	0.941	13.473
Marital status	Single	-	-	-	-	
	Married	-0.489	0.368	0.613	0.211	1.778
	Divorced	-0.772	0.268	0.462	0.118	1.809
Family history T2DM(Yes = 1, No = 0)	0.491	0.120	1.634	0.880	3.033	
Comorbidity(Yes = 1, No = 0)	0.135	0.653	1.145	0.635	2.062	
Residence(Urban = 1, Rural = 0)	0.117	0.727	1.124	0.584	2.163	
FBG	-0.001	0.756	0.999	0.993	1.005	
Disease duration T2DM	0.049	0.064	1.051	0.997	1.107	
% HbA1c(< 7 = 1, > 7 = 0)	-0.285	0.408	0.752	0.384	1.476	

N: number, T2DM: Type 2 Diabetes Mellitus

older age group than in people of a younger age group due to the presence of underlying diseases such as high blood pressure, elevated cholesterol and triglycerides [36]. In the results of this study, it was reported that there is a statistically significant relationship between the level of education and low quality of sleep in such a way that the sleep quality disorder was more prevalent in people with higher education than in people with lower education. The present study was consistent with the studies conducted in the northwest of Ethiopia (2020) [5]. However, it was not consistent with the studies conducted in Rasht-Iran (2022), and Malaysia (2022) [38, 39]. Although the exact reason is unknown, a possible explanation may be that people with higher education have different burdensome tasks such as studying for self-improvement, workload to increase income, and less job satisfaction [5]. Also, it was shown that a statistically significant relationship was observed between low sleep quality and depression, in such a way that for a one-unit increase in the mean depression score, the chance of low sleep quality increases by 1.13 times. The present study was consistent with the studies conducted in Saudi Arabia (2018), the USA (2019) and the Northwest-Ethiopia study (2020) [29, 34, 35]. Also, it was not consistent with the study conducted in Taiwan (2021) [28]. It is unclear whether poor sleep quality is a primary symptom of clinical depression. We hypothesize that poor sleep quality and psychological symptoms may mutually reinforce each other, resulting in a vicious cycle [40]. It is also possible that the relationship between sleep and depression is influenced by the use of drugs affecting sleep among people with chronic diseases [41]. In the present study, a significant association between depression and gender was observed, with women reporting depression more frequently than men. The present study was consistent with studies conducted in the Philippines (2019), Spain (2018), India (2021), and the United States (2021) [42–45]. To justify this, it can be pointed out that biological, hormonal, life cycle-related and psychosocial factors in women are associated with a higher degree of depression in women. Researchers have shown that hormones directly affect the brain, controlling a person's emotions and moods. For example, women are particularly prone to depression after childbirth. Also, many women face additional stress at work and doing housework, but it remains unclear why some women face major challenges that increase depression while others do not face the same challenges [46]. In the results of this study, it was shown that there is a statistically significant association between depression in people with diabetes and the amount of FBG. In this way, the amount of FBG also increases with increasing mean depression. The present study was consistent with studies conducted in southern Iran (2020), the Philippines (2019), India (2020), and southern Ethiopia (2020) [47–50]. To justify these

results, it is worth noting that a person suffering from T2DM and depression is more prone to poor glycemic control due to poor medication intake, which can lead to diabetes and related complications [47].

## Conclusion

According to the results of this study, it was shown that there is a significant association between sleep quality disorder and depression, gender, education, age and Family history T2DM In people with T2DM. Therefore, regular monitoring of people with T2DM may be recommended for health-care professionals to screen them for depression and also focus more on women, people with a positive family history T2DM, people with higher education and older people who are concerned about their sleep quality can improve to a certain extent.

## Limitations and suggestions

One of the limitations of this study was that it only looked at sleep quality and depression in people with T2DM. Therefore, it is recommended to design another study and examine in other types of diabetes (type 1 diabetes and gestational diabetes). Another limitation of this study is that it is a cross-sectional study and we cannot examine the causality between the variables.

Another limitation of the study is that there may be Volunteer Bias, in that people who visit health centers may care more about their health and, as a result, control their diabetes than those who do not visit. which is likely to weaken the observed relationship.

## Generalizability

Due to the fact that the sampling is done in a convenient manner, Due to the difference in health services and place of residence and the way of individual behavior and sleep hygiene and the difference of people who come to health centers may be different from other people making it difficult to generalize the results.

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## Declarations

**Conflict of interest** The authors declare that there is no conflict of interest in this study.

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