Original Article

Relationship between sleep quality and self-care behaviors in people with type 2 diabetes: descriptive-analytical study

Morteza Eshaghi[1] , Leily Sokoty[2], Meysam Farezi[3], Pary Mirshafiyi[4], Samad Darabian[5]*

[1]Department of Clinical Laboratory, School of Medicine, Arak University of Medical Sciences, Arak, Iran
[2]Clinical Research Development Unit, Taleghani Hospital, Tabriz University of Medical Sciences, Tabriz, Iran
[3]Department of Public Health, School of Health, Alborz University of Medical Sciences, Alborz, Iran
[4]Department of Non-Communicable Diseases, Vice-Chancellor of Health, Arak University of Medical Sciences, Arak, Iran
[5]Department of Statistics and Epidemiology, Faculty of Health, Isfahan University of Medical Sciences, Isfahan, Iran

Abstract

Introduction: Sleep deprivation is one of the common features of type 2 diabetes and a risk factor for impaired self-care behavior in diabetics. This study aimed to investigate the relationship between sleep quality and self-care behavior in people with type 2 diabetes in the city of Delijan in 2022.

Methods: This was a descriptive-analytical study conducted on 207 people with type 2 diabetes. The data were conveniently collected from health centers and homes in Delijan. Data collection tools included the Pittsburgh Sleep Quality Index (PSQI), the Summary of Diabetes Self-Care Activities Measure (SDSCA), clinical information about the disease (FBS, HbA1C levels, and duration of diabetes), and a checklist of demographic information. SPSS version 23 was used for data analysis. Data were analyzed using independent t-tests, ANOVA, and linear regression. The P value <0.05 was considered significant.

Results: The mean age (SD) of the participants was 58.67 (10.4) years. Most participants were female (66.7%). Among the demographic variables, family history of diabetes, chronic disease, and duration of disease with self-care behavior, gender and age showed a significant association with sleep quality. They also showed a significant correlation with sleep quality for the self-care components of smoking, foot care, and physical activity.

Conclusion: Based on the results, healthcare providers can be recommended to encourage type 2 diabetes for more physical activity, do not smoke, and careful foot care to improve sleep quality.

Introduction

Diabetes, one of the four major non-communicable diseases, has been defined by the World Health Organization as a public health problem with an increasing prevalence and patient population in recent decades.[1] It is estimated that 451 million people aged between 18 and 99 had diabetes in 2017, and it is expected to rise to 693 million by 2045.[2] Iran ranks third in the Middle East and North Africa region with nearly 5.4 million people with diabetes in 2019.[3-5] Sleep is essential to human health and a person typically spends a third of their life sleeping. Sleep disorders are common in patients with type 2 diabetes, and a previous study reported a high prevalence of sleep disorders in type 2 diabetics.[6-8] About 39.4% to 55% of these patients suffer from short sleep (less than 6.5 hours per night) and poor sleep quality.[8] People with type 2 diabetes have difficulty in falling asleep and maintaining sleep, daytime sleepiness, and poor sleep quality. These

sleep disorders are more common in people with type 2 diabetes than in the age- and sex-matched control group.[9] Experimental studies have shown that sleep deprivation and sleep disorders decrease glucose tolerance and insulin sensitivity, suggesting that sleep disorders may be caused by increased sympathetic nervous system activity, elevated cortical levels at night, and decreased glucose utilization in the brain.[10] Oda et al believe that patients with type 2 diabetes can control their blood sugar levels by improving their ability to sleep in several ways.[11]

Sleep disorders not only lead to psychological and social complications in patients with diabetes but can also be a risk factor for impaired self-care behavior.[12,13] Self-care is the purposeful and learned activities that a person undertakes to sustain life and ensure the maintenance and promotion of health and family life.[14] Diabetes self-care includes a range of activities to manage the disease. This means that the patient bears a high level of responsibility

for adhering to the therapy. The main goal of diabetes self-care is to keep glycemic control at normal levels, and preventing or delaying complications.[15] Diabetes self-care includes seven key activities that predict treatment success. These activities include healthy eating, physical activity, blood glucose monitoring, medication adherence, good problem-solving skills, healthy coping skills, and risk-reducing behaviors.[16-18] All these activities have a positive association with controlling the patient's blood sugar levels, reducing complications, and improving the quality of life of diabetics.[17] Therefore, the purpose of this study was to investigate the association between sleep quality and self-care behaviors among people with type 2 diabetes.

Methods and Materials

This descriptive-analytical study was conducted in Delijan, located in the Markazi province. The patients who were referred to the centers were included in the study using convenience sampling method. The method of data collection was also in such a way that after the meeting was held with the health care workers and rehabilitators, the necessary training was given to the clients on how to ask the questions. Then, the questionnaires were distributed to all health and treatment centers (8 centers) and health houses (11 houses) and they were asked to provide information related to the questionnaire only through the presence of patients who refer to the centers. It was also emphasized to request the clients to complete and submit the questionnaires. Information was collected through interviews with people who did not have enough literacy to fill out the questionnaire. Based on the study by Gurmu et al,[19] using the standard deviation of self-care in diabetic patients (9.5%), alpha of 0.05 and the accuracy of 1.3, 207 people were estimated to be included in this study. Inclusion criteria were people over 30 years of age with a history of diabetes for more than one year who do not suffer from any known mental disorders. Exclusion criteria were people who did not complete the questionnaire or refused to continue participation in the research. Upon enrollment, participants completed a series of linked questionnaires, which included the Pittsburgh Sleep Quality Index (PSQI), the Summary of Diabetes Self-Care Activities (SDSCA), clinical information about the disease (e.g., FBS and HbA1c levels, duration of diabetes), and a demographic checklist (age, gender, education level, marital status, comorbidity with other diseases, and place of residence). Also, to avoid information bias (especially among elderly and illiterate people) in expressing the amount of fasting blood sugar and hemoglobin A1C, information through the latest tests during the last month were registered in the integrated health system. We performed these tests for free for people who did not have a fasting blood sugar and hemoglobin A1C test in the last month.

Measurement tools

The 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, and 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.[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.[21-22]

The SDSCA

The SDSCA is a 15-item questionnaire that examines patients' self-care activities over the past seven days. This questionnaire has a Likert scale from 0 to 7, with a score of 0 representing non-compliance with self-care and 7 representing full compliance with self-care. This scale includes various aspects of diabetes management, including diet, exercise, blood glucose testing, insulin injections or antidiabetic medications, foot care, and smoking. On this scale, the extraordinary behavior of smoking is given a score from 0 to 1, and the remaining behaviors are given a score from 0 to 7. An overall adherence rating is obtained by adding up the scores for each question. The total score on the scale ranges from 0 to 99. To determine the self-care status of diabetics, they were divided into three categories: poor self-care with a score of 0-33, moderate self-care with a score of 34-67 and strong self-care with a score of 68-99.[23] In Iran, the validity of the quantitative method for the content validity and reliability of the questionnaire was confirmed with Cronbach's alpha of 79%.[24]

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 variables. After measuring the normality of the data using the Kolmogorov-Smirnov test, independent t-tests, analysis of variance (ANOVA), Pearson's correlation, and linear regression were used. All statistical tests were performed using SPSS version 23 and $P < 0.05$ was considered significant.

Results

The mean age of the participants was 58.67 years. Most of the participants were female (n = 138, 66.7%), illiterate (n = 78, 37.7%) and married (n = 183, 88.4%). Besides, 147 people (71%) had a family history of diabetes, 127 people (61.4%) had another chronic disease besides diabetes, and

147 participants lived in the urban area. The mean (SD) of FBS and HbA1c was 149.49 (48.12) mg/dl and 6.78 (0.94) %, respectively. Also, the mean duration of diabetes in the participants was almost 8 years (Table 1).

In the study group, only 25 people had a good level of self-care. Also, 115 people had a mean self-care level and 67 people had a poor self-care level. Among the self-care components, monitoring blood sugar had the lowest mean score of self-care, and adherence to medication had the highest mean score of self-care. Additionally, 95 participants had good sleep quality and 112 people had poor sleep quality. Among the demographic variables, a statistically significant relationship was observed between the family history of diabetes ($P < 0.01$) and other chronic diseases/comorbidities ($P < 0.00$) with self-care behaviors. Thus, self-care behaviors were higher in people with a positive family history and people who had other chronic diseases besides diabetes. However, no statistically significant difference was observed between other demographic variables and self-care behaviors (Table 2).

Among the demographic variables, gender ($P < 0.04$) and having another chronic disease ($P < 0.02$) had a statistically significant relationship with sleep quality. There was low sleep quality in women and people who had other chronic diseases in addition to diabetes. However, no statistically significant relationship was observed between other demographic variables and sleep quality (Table 3).

No statistically significant relationship was observed between FBS, HbA1c and sleep quality variables and self-care behaviors. A direct relationship was observed between the age of the patients and sleep quality ($P < 0.01$). Also, a statistically significant relationship was observed between the duration of diabetes and self-care behaviors ($P < 0.04$). People with diabetes were more likely to show better self-care behaviors. Of the six components of self-care behaviors, between physical activity ($P < 0.01$) and foot care ($P < 0.03$) with sleep quality, a statistically inverse relationship was observed, and there was also a statistically significant difference between people who smoked and those who did not smoke ($P < 0.001$) (Table 4).

Multivariate regression was used to predict sleep quality according to self-care components. The predictive role of smoking, foot care, and physical activity variables is significant (Table 5). Also, the results showed that these variables explain 20.3% of the variance in sleep quality.

Discussion

The results of present study were consistent with those of previous studies in Iran, and most participants had an average level of self-care.[25,26] The results were also consistent with the studies conducted in Ethiopia and Malaysia, and checking blood sugar levels and medication compliance were the lowest and highest components of self-care, respectively.[19,27] However, our results were not consistent with those of studies previously conducted in Kenya, Iran, Northwest, and Ethiopia, which showed higher levels of self-care (41%, 39%, 28.4%, and 54.3%, respectively).[22,28-30] The reasons for these discrepancies can be originated from the different leveling of measurement tools, cultural-economic differences and higher education levels in the mentioned studies with our study. In our results, people who had a positive family history of diabetes had better self-care behaviors than people who did not have, and this difference was statistically significant, consistent with a study conducted in Kerman-Iran.[24] However, our results were not consistent with the studies of Tabriz-Iran, Pakistan, and Western Ethiopia.[31-33] In justification of the obtained results, it can be pointed out that having

Table 1. Demographic characteristics of people participating in the study (N = 207)

Variable		N	%
Gender	Male	69	33.3
	Female	138	66.7
Education	Illiterate	78	37.7
	Elementary	72	34.8
	Diploma	41	19.8
	≥ Bachelor	16	7.7
Marital status	Single	4	1.9
	Married	183	88.4
	Divorced	20	9.7
Familiar history	Yes	147	71.0
	No	60	29.0
Comorbidity	Yes	127	61.4
	No	80	38.6
Residency	Rural	147	71.0
	Urban	60	29.0

Table 2. Relationship between self-care behaviors and demographic variables in people with type 2 diabetes (N = 207)

Variable		N	Mean (SD)	P value
Gender	Male	69	42.26(15.82)	0.70
	Female	138	43.25(21.50)	
Education	Illiterate	78	41.16(21.82)	0.55
	Elementary	72	44.39(18.85)	
	Diploma	41	41.81(17.97)	
	≥ Bachelor	16	47.74(17.86)	
Marital status	Single	4	54.00(11.10)	0.16
	Married	183	42.00(18.95)	
	Divorced	20	49.20(26.41)	
Familiar history	Yes	147	44.97 (20.71)	0.01
	No	60	37.91 (16.29)	
Comorbidity	Yes	127	46.65(19.09)	< 0.001
	No	80	37.01(19.46)	
Residency	Rural	147	42.32(18.69)	0.58
	Urban	60	44.11(22.32)	

Table 3. Relationship between sleep quality and demographic variables in people with type 2 diabetes (N = 207)

Variable		N	Mean (SD)	P value
Gender	Male	69	4.72(2.72)	0.04
	Female	138	5.54(3.03)	
Education	Illiterate	78	5.88(3.13)	
	Elementary	72	4.94(2.94)	0.07
	Diploma	41	4.56(2.49)	
	≥Bachelor	16	5.56(2.75)	
Marital status	Single	4	4.00(1.63)	
	Married	183	5.20(2.92)	0.27
	Divorced	20	6.15(3.31)	
Familiar history	Yes	147	5.44(2.90)	0.19
	No	60	4.85(3.04)	
Comorbidity	Yes	127	5.62(3.14)	0.02
	No	80	4.71(2.53)	
Residency	Rural	147	5.22(2.94)	0.69
	Urban	60	5.40(3.02)	

Table 4. Correlation between sleep quality and six components of self-care behaviors

Variable		N	Correlation	P value
Diet		207	-0.042	0.63
Physical activity		207	-0.211	0.01
Blood sugar monitoring		207	0.06	0.43
Foot care		207	-0.165	0.03
Taking medication		207	-0.05	0.56
Smoking	Yes	44	Mean (SD): 7.20 (3.34)	<0.001
	No	163	Mean (SD): 4.78 (2.61)	

a family history of diabetes was associated with better knowledge of diabetes risk factors, daily consumption of more fruits and vegetables, and participation in diabetes screening, which led to better self-care behaviors than people without a family history.[34] Self-care behaviors in people who have other chronic diseases besides diabetes are better than people who only have diabetes. Our results were consistent with a study conducted in South Korea, as well as with a study conducted in the United States and the Netherlands, and a strong correlation was observed between the number of comorbidities and the use of general practitioner care, specialized outpatient care, better adherence to medications and reduction in healthcare costs.[35-37] However, it was not consistent with the studies conducted in western Ethiopia.[30,32] One reason for this discrepancy may be the difference in self-care practices due to easier access to health-related activities in the current study environment compared to previous studies conducted in Ethiopia. In this study, there was a direct relationship between the duration of diabetes and self-care, and this relationship was statistically significant. The present study was consistent with the study conducted in Ethiopia.[19] However, it was not consistent

Table 5. Relationship between self-care behaviors and sleep quality in people with type 2 diabetes using multivariate regression (N = 207)

Variable	Beta	95% Confidence Interval		P value
		Lower Bound	Upper Bound	
Smoking	-0.335	-1.458	-3.359	<0.001
Foot care	0.101	0.088	-0.014	0.047
Taking medication	-0.032	0.133	-0.204	0.678
Blood sugar monitoring	0.048	0.159	-0.078	0.504
Physical activity	-0.195	0.178	-0.104	0.020
Diet	-0.070	0.040	-0.094	0.428

with the studies conducted in Iran, South Korea, Pakistan, India, and America.[12,31,35,38] Prolonging the duration of the disease leads to an improvement in awareness of the disease, which is related to an increase in self-care.[39] The results showed that more than half of people with type 2 diabetes were faced with poor sleep quality which was consistent with studies conducted in Saudi Arabia (2018), the United States (2019), and South Korea (2016).[40-42] Chicago (2018), Japan (2018) and China (2016).[43-45] We know that sleep restriction has potential effects on neuro-hormones, endocrine glands, and metabolism, such as the production of higher levels of cortisol in the evening, which leads to a decrease in insulin sensitivity the next morning. In addition, the activity of the sympathetic nervous system will be higher in sleep problems. So such responses to sleep problems may impair glucose metabolism and decrease levels of metabolic hormones such as leptin and insulin.[41] Our results showed that there was a statistically significant relationship between gender and sleep quality in people with type 2 diabetes. Our study was consistent with studies conducted in Saudi Arabia (2018), the USA (2019), Japan (2018), and Malaysia (2022).[40,42,43,46] The potential reason for the low sleep quality in women may be related to significant hormonal changes related to age, as well as more psycho-social stress in them.[47] In the present study, a statistically significant relationship was observed between the quality of sleep and the co-occurrence of diabetes with other chronic diseases, and people with other chronic diseases in addition to diabetes had a lower quality of sleep. In Saudi (2018), people who had comorbidity with another chronic disease had a lower quality of sleep.[40] In Northwestern Ethiopia (2020), the quality of sleep in people with comorbidity was almost twice that of people who only had diabetes.[48] However, this relationship was not observed in a study conducted in South Korea (2016).[41] Comorbidities may lead to poor blood sugar control, more chronic complications and an increase in emotional quality, which can lead to poor homeostasis and poor sleep quality.[48] In our study, there was a direct relationship between age and the quality of sleep in such a way that the quality of sleep of people with diabetes decreases with age which was consistent with a study conducted in Saudi Arabia (2018), Chicago (2018), and Ethiopia (2020),[40,44,49] but not consistent

with the studies performed in South Korea (2016) and Turkey (2015).[41,50] Possible explanations for this could be increased sleep latency, frequent awakenings, early morning awakenings, and lack of deep sleep, all of which may be the result of deterioration in sleep/wake homeostasis and circadian rhythms with age. The function of the hypothalamus, which controls the sleep/wake homeostasis cycle and the circadian rhythm decreases in older age.[49,50] Also, there was a statistically significant relationship between smoking from the self-care components and the quality of sleep, showing that the quality of sleep among smokers with diabetes was higher than non-smokers with diabetes (i.e., non-smokers had better sleep quality). Our study was consistent with the studies done in Jordan (2019), Saudi Arabia (2018) and Japan (2018).[40,43,51] The possibility that smoking diabetic patients suffer from low quality of sleep is most likely due to the effect of nicotine consumption on the brain because nicotine is a mild stimulant for the central nervous system. This relationship can be explained by the effect of snoring caused by decreased breathing (hypopnea) and decreased oxygen saturation due to smoking.[51] In the present study, an inverse relationship was observed between physical activity, one of the components of self-care, and sleep quality. In this way, the people who scored high on the physical activity component had a lower average sleep quality score, i.e., they had better sleep quality. The present study was consistent with the study conducted in Saudi Arabia (2018) and Sweden (2011).[40,52] However, it did not agree with the study in Iran (2016) and South Korea (2016).[41,53] Physiological changes during physical activity, such as an increase in body temperature, an improvement in heart rate and a reduction in psychological symptoms can improve sleep quality.[54] In the present study, a statistically significant association was observed between the foot care component and sleep quality. In this way, people who scored high in the foot care component had a lower average sleep quality score, i.e., they had better sleep quality. The present study was consistent with the study conducted in London (2011) and Africa (2021), which reported that sleep quality in diabetics with foot complications was approximately five times higher than that in diabetics who did not have foot complications.[55,56]

Conclusion

In the present study, it was shown that more than half of the people had an average level of self-care and a few people had a good level of self-care. Checking blood sugar levels and taking medication also showed the lowest and highest average self-care scores, respectively.

Study Highlights

What is current knowledge?

- Sleep quality and diabetes are closely linked. Sleep disorders can make it more difficult to control blood sugar, and high blood sugar levels can lead to sleep disorders.
- Diabetes self-care includes a set of actions that a person with diabetes takes to control the disease and prevent its complications. By taking this care, people with diabetes can live healthy and active lives.

What is new here?

- This study was conducted to find the relationship between sleep quality and self-care in people with diabetes. This study showed that sleep quality in diabetics is significantly related to self-care activities such as physical activity, smoking, and foot care.

Author's Contribution

Conceptualization: Samad Darabian.
Data curation: Meysam Farezi.
Formal analysis: Samad Darabian.
Funding acquisition: Meysam Farezi.
Investigation: Morteza Eshaghi.
Methodology: Samad Darabian.
Project administration: Morteza Eshaghi.
Resources: Leily Sokoty.
Software: Leily Sokoty.
Supervision: Samad Darabian.
Validation: Pary Mirshafiyi.
Visualization: Morteza Eshaghi.
Writing–original draft: Samad Darabian.
Writing–review & editing: Pary Mirshafiyi.

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