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## Observational Study

**Quality of sleep and its determinants among people with type 2 diabetes mellitus in Northwest of Iran**

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**Abstract****AIM**

To examine sleep quality and its determinants among people with type 2 diabetes mellitus (T2DM).

**METHODS**

This is a cross-sectional study conducted among diabetic patients referring to Ardabil diabetes clinic in Northwest of Iran. Information on sleep quality was collected using Pittsburg Sleep Quality Index (PSQI). A questionnaire was used to collect data on sociodemographic lifestyle factors and psychological distress. This questionnaire was completed through an interview, and clinical information was extracted from patient's record. Data analysis was done using SPSS software version 23 and univariate and

multivariate analyses.

## RESULTS

Study participants consist of 256 people with T2DM the majority of whom were women (70%), and mean age of participants was  $54.06 \pm 9.09$ . The mean of total score of PSQI was  $5.56 \pm 3.34$ . Relative to younger age group, the middle-aged people with T2DM were twice more likely to be poor sleeper; the adjusted OR was 2.03 (95%CI: 1.01-4.08); and those with longer duration of diabetes were about 1.8 times more likely to report poor quality of sleep (OR<sub>adj</sub> = 1.77, 95%CI: 0.98-3.13). Participants with cholesterol level  $\geq 240$  mg/dL were about twice more likely to be poor sleeper (OR<sub>adj</sub> = 1.99, 95%CI: 1.01-3.94). The odds of being poor sleeper increased as the level of distress increased (1.84-4.09).

## CONCLUSION

As indicated by the results of the present study, some factors including age, duration of disease, psychological distress and high level of cholesterol were independently associated with poor sleep quality.

**Key words:** Type 2 diabetes mellitus; Lifestyle; Pittsburg Sleep Quality Index; Hypercholesterolemia; Psychological distress

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**Core tip:** In Iran, diabetes is one of the health concerns with a prevalence of 8.5% because of lifestyle changes following rapid urbanization. Few studies have been conducted in Iran concerning quality of sleep among people with type 2 diabetes mellitus. Therefore, the present study aimed to examine the quality of sleep among people with type-2 diabetes referring to diabetes clinic in Ardabil, Northwest of Iran where diabetes is a health research priority in this province. The results showed that, age, duration of disease, psychological distress and high level of cholesterol were independently associated with poor sleep quality. Therefore, promotion of diabetes management, regular primary care and psychological consultation are recommended in order to improve sleep quality among people with type 2 diabetes.

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## INTRODUCTION

Diabetes is one of the most important health concerns in societies<sup>[1]</sup>, and according to estimates by the International Federation of Diabetes (IDF), there were

415 million adults with diabetes around the globe in 2015, even increasing in the following years<sup>[2]</sup>.

Sleep disorder as a new risk factor for diabetes plays an important role in diabetes occurrence through neuro-metabolic pathway<sup>[3-5]</sup>. Cortisol level increases following sleep deprivation which inhibits insulin production and may induce pre-diabetic or diabetic states in long term. In addition, insulin sensitivity is reduced following the sleep disorder, and impairment in sleep quality or quantity is consequently followed by blood glucose elevation affecting the process of development of diabetes<sup>[6]</sup>. It has been shown that reduction in duration of night sleep to four h over six successive nights can cause Impaired Glucose Tolerance (IGT) in adults<sup>[7]</sup>. In people with diabetes, a balance between insulin secretion and glucose uptake is impaired; therefore, following sleep deprivation due to high level of cortisol and reduced glucose metabolism, glucose levels is increased causing diabetes aggravation<sup>[8]</sup>.

A range of sleep disorders are common among people with T2DM, including sleep apnea, insomnia, periodic limb movements, circadian rhythm, sleep hygiene and psychoactive drug use, which, in sleep apnea, is the most common reported disorder<sup>[9,10]</sup>.

There is evidence that approximately one third of people with diabetes suffered from sleep problems whilst it was only 8.2% in control group without DM<sup>[11]</sup>. In another study, more than half of the people with T2DM were "poor sleepers"<sup>[12]</sup>. It has also been shown that using the Pittsburg Sleep Quality Index (PSQI) as the validated tool for measuring quality of sleep<sup>[9]</sup>, lower score of PSQI were reported by people with type 2 diabetes<sup>[13]</sup>. Evidence showed that poor sleep quality among people with T2DM is associated with longer duration of diabetes, poor glycemic control (hemoglobin A1c > 7%), normal body mass index, and hypertension<sup>[13]</sup>. Studies also reported that the high prevalence of poor sleep quality among people with T2DM has a negative impact on glycemic control<sup>[14,15]</sup>. A recent systematic review and meta-analysis revealed that poor quantity and quality of sleep were associated with an increased HbA1C<sup>[16]</sup>. Therefore, sleep quality improvement plays an important role in glycemic control among people with T2DM. A good sleep quality should be considered as an important component in the prevention and management of T2DM.

In Iran, diabetes is one of the health concerns with a prevalence of 8.5% due to lifestyle changes following rapid urbanization<sup>[2]</sup>. Few studies have been conducted in Iran concerning quality of sleep among people with T2DM<sup>[17,18]</sup>. We could not find any published paper in this regard in northwest of Iran; therefore, the present study aimed at examining the quality of sleep among people with type-2 diabetes referring to diabetes clinic in Ardabil, Northwest of Iran where diabetes is a health research priority<sup>[19]</sup>, and inadequate quality of care has been reported in some regional studies and literature<sup>[20,21]</sup>. We aimed at assessing a range of

different socioeconomic and diabetes care factors as well as psychological distress regarding sleep quality among people with T2DM.

## MATERIALS AND METHODS

The present study is a cross-sectional study conducted between June 2013 and March 2014 consisting of 256 type-2 diabetic patients referring to diabetes clinic of Ardabil. This clinic is located in Imam Khomeini Hospital in Ardebil, Northwest of Iran providing specialty and subspecialty services for diabetic patients referring from the neighboring towns and villages of Ardabil province. Inclusion criteria were possession of healthcare profile in the clinic, diagnosed with type II diabetes and being in the age range of 20-70 years. Demographic information and the characteristics of the disease, treatment and the care measure variables such as body mass index (BMI), blood pressure, cholesterol and HbA<sub>1c</sub> were collected. Information on sleep quality was obtained using PSQI<sup>[22]</sup>. This questionnaire evaluates 7 aspects of sleep quality including sleep quality, delay in falling asleep, sleep duration, normal quality of sleep, sleep disturbance, use of sleep medications and dysfunction during the day. The score range of the questionnaire is between 0 and 21, and a score of above 5 is considered as sleep disorder (higher scores indicate higher level of sleep disorder). The Persian version of the questionnaire is composed of 9 main questions; questions 1-4 are related to sleep and waking h and are responded quantitatively and questions 5-9 are scored using a 0-3 Likert scale. Question 5 has 10 subsets investigating problems related to sleep over the past month. The reliability and validity of the Persian version of this questionnaire are confirmed<sup>[23]</sup>. Patients were classified into two groups according to PSQI: Poor-sleeper group (PQSI > 5) and good-sleeper group (PQSI ≤ 5)<sup>[22]</sup>. Psychological distress was assessed using the Kessler's Psychological Distress Scale (K10). Questions are scored using a five likert scale; all of the time, most of the time, some of the time, a little of the time and none of the time. The maximum score is 50 indicating severe distress; the minimum score is 10 indicating no distress<sup>[24]</sup>. Patients were divided into 4 groups according to K10 score; no distress (< 20), mild (20-24), moderate (25-29), and severe (30 and higher). The reliability and validity of the Persian version of this questionnaire has been confirmed<sup>[25]</sup>.

Questionnaires were completed by two trained staff in the diabetes clinic of Ardabil *via* a face-to-face interview. The study data were analyzed using descriptive and analytical statistical techniques through SPSS software version 23. Univariate and multivariate logistic regression models with classified PSQI score as poor (> 5) vs good (≤ 5) sleepers were used as dependent variable to estimate crude and adjusted odds ratios (ORs) with 95% confidence intervals (CI). Adjustment was performed for gender, age, diabetes duration, treatment options, complications, HbA<sub>1c</sub>,

**Table 1 Demographic characteristics of the patients with type-2 diabetes in diabetes clinic of Ardabil (n = 256) in 2014**

| Characteristics             | n (%)      |
|-----------------------------|------------|
| Age group (yr)              |            |
| < 50                        | 68 (26.6)  |
| 50-59                       | 113 (44.1) |
| > 60                        | 75 (29.3)  |
| Sex                         |            |
| Male                        | 75 (29.3)  |
| Female                      | 181 (70.7) |
| Education                   |            |
| Illiterate                  | 127 (49.6) |
| Primary school              | 70 (27.3)  |
| Secondary school and higher | 59 (23)    |
| Income                      |            |
| Low (< 500)                 | 151 (71.6) |
| Acceptable                  | 60 (28.4)  |
| Marital status              |            |
| Married                     | 227 (88.7) |
| Single/divorced/widow       | 29 (11.3)  |
| Occupation                  |            |
| In-paid work                | 41 (16)    |
| Not working                 | 215 (84)   |
| Smoking                     |            |
| Yes                         | 232 (92.4) |
| No                          | 19 (7.6)   |
| Body mass index             |            |
| < 25                        | 49 (19.1)  |
| 25-29.9                     | 101 (39.5) |
| ≥ 30                        | 106 (41.4) |

cholesterol level, hypertension, BMI, and psychological distress (K10). Significance level was set at 0.05 ( $P < 0.05$ ).

This study is a part of a diabetes care project approved by the Medical Ethics Committee of Tabriz University of Medical Sciences (Ethic Number: TBZ-MED.1392.5.4.7580). Moreover, a written consent was obtained from all of the participants.

## RESULTS

The mean age of the patients was  $54.06 \pm 9.09$ , and most of the patients were women (71%). The majority were married living with their spouse at the time of the research (89%). About 50% of the participants were illiterate and, only 3.5% had a university degree. The majority had low income level (72%), and only 16% were engaged in in-paid work. 8% of study population were smokers, and only 19% had normal weight (Table 1).

The patients' mean of real sleep h was  $6.71 \pm 1.45$ . In response to the question "During the past month, how would you rate your sleep quality overall?" 15.7% of the patients reported their sleep quality good, 61% relatively good, 19.3% relatively bad, and 3.9% very bad. Moreover, about 23.1% of the patients reported their real sleep h below 5 h, and 10.4% more than 9 h.

In univariate analysis, people in age group 50-59 were more frequently reported to be poor sleepers followed by those in age group 60 and over; the

**Table 2** Quality of sleep among diabetic patients by socio-demographic and clinical factors, 2014-2015, Northwest of Iran *n* (%)

| Characteristics              | Total | PQSI ≤ 5 (good sleepers) | PQSI > 5 (poor sleepers) | <i>P</i> value <sup>1</sup> |
|------------------------------|-------|--------------------------|--------------------------|-----------------------------|
| Age group (yr)               |       |                          |                          | 0.136                       |
| < 50                         | 68    | 48 (70.6)                | 20 (29.4)                |                             |
| 50-59                        | 113   | 63 (55.8)                | 50 (44.2)                |                             |
| ≥ 60                         | 75    | 47 (62.7)                | 28 (37.3)                |                             |
| Sex                          |       |                          |                          | 0.294                       |
| Male                         | 75    | 50 (66.7)                | 25 (33.3)                |                             |
| Female                       | 181   | 108 (59.7)               | 73 (40.3)                |                             |
| Education                    |       |                          |                          | 0.518                       |
| Illiterate                   | 127   | 74 (58.3)                | 53 (41.7)                |                             |
| Primary school               | 70    | 45 (64.3)                | 25 (35.7)                |                             |
| Secondary school and higher  | 59    | 39 (66.1)                | 20 (33.9)                |                             |
| Income                       |       |                          |                          | 0.662                       |
| Low (< 500)                  | 151   | 93 (61.6)                | 58 (38.4)                |                             |
| Acceptable                   | 60    | 35 (58.3)                | 25 (41.7)                |                             |
| Marital status               |       |                          |                          | 0.96                        |
| Married                      | 227   | 136 (59.9)               | 91 (40.1)                |                             |
| Single/divorced/widow        | 29    | 22 (68.2)                | 7 (31.8)                 |                             |
| Occupation                   |       |                          |                          | 0.552                       |
| In-paid work                 | 41    | 27 (65.9)                | 14 (34.1)                |                             |
| Not working                  | 215   | 131 (60.1)               | 84 (39.1)                |                             |
| Duration of disease (yr)     |       |                          |                          | 0.003                       |
| < 6                          | 114   | 82 (71.9)                | 32 (28.1)                |                             |
| ≥ 6                          | 140   | 75 (53.6)                | 65 (46.4)                |                             |
| Complications                |       |                          |                          | 0.013                       |
| No                           | 134   | 92 (68.7)                | 42 (31.3)                |                             |
| Yes                          | 118   | 63 (63.4)                | 55 (46.6)                |                             |
| Smoking                      |       |                          |                          | 0.18                        |
| Yes                          | 19    | 9 (47.4)                 | 10 (52.6)                |                             |
| No                           | 232   | 146 (62.9)               | 86 (37.1)                |                             |
| BMI                          |       |                          |                          | 0.84                        |
| < 25                         | 49    | 32 (65.3)                | 17 (34.7)                |                             |
| 25-29.9                      | 101   | 61 (59.4)                | 40 (39.6)                |                             |
| ≥ 30                         | 106   | 65 (61.3)                | 41 (38.7)                |                             |
| HbA1C                        |       |                          |                          | 0.882                       |
| < 7                          | 91    | 57 (62.6)                | 34 (37.4)                |                             |
| ≥ 7                          | 165   | 101 (61.2)               | 64 (38.8)                |                             |
| Hypertension                 |       |                          |                          | 0.089                       |
| Controlled                   | 81    | 56 (69.1)                | 25 (30.9)                |                             |
| Uncontrolled                 | 149   | 86 (57.7)                | 63 (42.3)                |                             |
| Total cholesterol            |       |                          |                          | 0.016                       |
| Desirable                    | 205   | 134 (65.4)               | 71 (34.6)                |                             |
| ≥ 240                        | 51    | 24 (47.1)                | 27 (52.9)                |                             |
| Psychological distress (K10) |       |                          |                          | < 0.001                     |
| No                           | 88    | 67 (76.1)                | 21 (23.9)                |                             |
| Mild                         | 85    | 54 (63.5)                | 31 (36.5)                |                             |
| Moderate                     | 46    | 22 (47.8)                | 24 (52.2)                |                             |
| Severe                       | 37    | 15 (40.5)                | 22 (59.5)                |                             |
| Treatment option             |       |                          |                          | 0.584                       |
| Oral medication              | 149   | 91 (61.1)                | 58 (38.9)                |                             |
| Insulin + oral OR            | 74    | 44 (59.5)                | 30 (40.5)                |                             |
| Insulin                      |       |                          |                          |                             |
| Other                        | 33    | 23 (69.7)                | 10 (30.3)                |                             |

<sup>1</sup>*P* value was reported based on univariate and multivariate logistic regression tests.

same was true for women than men; however, the associations were not statistically significant. Poor sleep

quality decreased as education level increased. In other words, the number of poor sleepers was the highest among illiterate study participants. Poor sleep was more common in married, low income and not-working study population (Table 2). In regard with lifestyle and diabetes care measures, people with diabetes with longer duration of disease (> 6 years), complications, and those with high level of cholesterol were more likely to report poor sleep quality. Hypertension, poor glycemic control (HbA1C level ≥ 7), BMI, smoking and treatment option were not significantly associated with sleep quality. Study participants with higher score of psychological distress were more likely to be poor sleepers compared to those with no distress. Poor sleep quality increased as the score of psychological distress increased (*P* value < 0.001).

In multivariate logistic regression model, only duration of disease, age, cholesterol level, and psychological distress were remained as independent predictors of sleep quality (Table 3). Relative to younger age group, the middle-aged people with T2DM were twice more likely to be poor sleeper. The adjusted OR was 2.03 (95%CI: 1.01-4.08) for age group 50-59 years. Those with longer duration of diabetes were about 1.8 times more likely to report poor quality of sleep than those with shorter period of disease (OR<sub>adj</sub> = 1.77, 95%CI: 0.98-3.13). Study participants with cholesterol level ≥ 240 mg/dL were about twice more likely to be poor sleeper compared to those with desirable level of cholesterol (OR<sub>adj</sub> = 1.99, 95%CI: 1.01-3.94). The odds of being poor sleeper increased as the level of distress increased (1.84-4.09); with the highest level in those with severe psychological distress compared to those with no distress (OR<sub>adj</sub> = 4.09, 95%CI: 1.71-9.77).

## DISCUSSION

The present study investigated the quality of sleep and its correlates among people with T2DM referring to diabetes clinic of Ardabil, Northwest of Iran. The results of the present study indicated that 38% of the patients were classified as poor sleeper (PSQI > 5) less than other studies reporting 46-71 percent of the patients with PSQI scores above 5<sup>[12,18,26,27]</sup>.

In this study, the mean of PSQI total score was 5.56 ± 3.34 which was similar to those reported by Ghanei *et al.*<sup>[18]</sup> (5.5 ± 4.4). However, it was lower than other studies which reported greater mean score of PSQI<sup>[18,27,28]</sup>. In this study, 66.5% of participants reported their adequate sleep between 6-8 h; similar findings were reported from other studies conducted in Iran<sup>[29]</sup>. Moreover, in the present study, 10.4% of the patients had real sleep duration of equal or more than 9 h, and about 21% of the patients reported their real sleep duration to be ≤ 5 h higher than the other<sup>[7,30]</sup>. Based on a meta-analysis conducted in 2010, lack of sleep or insufficient sleep and long sleep duration were known as risk factors of T2DM<sup>[31]</sup>. According to the results of different studies,

**Table 3 Predictors of sleep quality among diabetic patients (outcome poor sleeper vs good sleepers)**

| Characteristics              | OR crude (95%CI)     | OR adjusted (95%CI) |
|------------------------------|----------------------|---------------------|
| Age group (yr)               |                      |                     |
| < 50                         | Ref                  | Ref                 |
| 50-59                        | 1.905 (1.004-3.613)  | 2.033 (1.014-4.077) |
| ≥ 60                         | 1.430 (0.709-2.881)  | 1.223 (0.561-2.668) |
| P value                      | 0.139                | 0.097               |
| Duration of disease (yr)     |                      |                     |
| < 6                          | --                   | --                  |
| ≥ 6                          | 2.221 (1.312-3.760)  | 1.767 (0.981-3.182) |
| P value                      | 0.003                | 0.058               |
| Complications                |                      |                     |
| No                           | Ref                  | Ref                 |
| Yes                          | 1.912 (1.144-3.197)  | 1.438 (0.805-2.568) |
| P value                      | 0.013                | 0.219               |
| Psychological distress (K10) |                      |                     |
| No distress                  | Ref                  | Ref                 |
| Mild distress                | 1.832 (0.947-3.543)  | 1.835 (0.910-3.701) |
| Moderate distress            | 3.481 (1.631-7.429)  | 3.282 (1.430-7.533) |
| High distress                | 4.679 (2.063-10.615) | 4.087 (1.710-9.765) |
| P value                      | < 0.001              | 0.005               |
| Total cholesterol            |                      |                     |
| Desirable                    | Ref                  | Ref                 |
| ≥ 240                        | 2.123 (1.142-3.949)  | 1.989 (1.006-3.935) |
| P value                      | 0.017                | 0.048               |

P value was reported based on univariate and multivariate logistic regression tests. Only variables with significant association in either univariate or multivariate models have been reported. Dependent variable: Sleep quality; OR: Odds ratio.

risk of death from cardiovascular diseases and symptoms of diabetes increase among people who sleep less than 7 or more than 8 h a day<sup>[32]</sup>.

Our results showed that only duration of disease, age, cholesterol level, and psychological distress remained as independent predictors of sleep quality. These findings were in agreement with the results of some studies<sup>[12,13]</sup>. In addition, similar to our results, another study found that diabetic people with poor sleep quality had higher total cholesterol compared to those with good sleep quality<sup>[29]</sup>. In this study, gender, hypertension, HbA<sub>1c</sub>, complications, treatment options, and BMI were not significantly associated with sleep quality. In contrast, the results of a study carried out by Maracy *et al*<sup>[33]</sup> indicated that sleep quality among women was worse than that of men. The majority of study participants in our study were women; therefore, gender differences could not be fully assessed.

Unlike our study, a significant relationship between HbA<sub>1c</sub> and PSQI has been reported while the association between the patients' fasting blood sugar (FBS), blood pressure, LDL, triglyceride, and BMI was not statistically significant<sup>[18,26,33]</sup>. A linear correlation between sleep duration and glycemic control among type 2 diabetics has been reported<sup>[34]</sup>. A recent study found a significant relationship between overweight/obesity = with sleep quality among people with diabetes<sup>[35]</sup>.

Regarding the negative effects of treatment with insulin on diabetic patients and reduction of satisfaction

among patients treated with insulin injection<sup>[36,37]</sup>, in the present study, the percentage of poor sleeper was a bit higher among those treated through insulin injection alone or with oral medication (40% compared to 39% in oral medication group) and much higher than other treatment group, though the difference was not statistically significant. There are some studies that showed the associations between poor sleep quality and insulin therapy<sup>[12,26,38]</sup>. The current study found that the odds of being poor sleeper increased as the level of psychological distress increased from 1.84 to 4.09. There is evidence that depression is an independent predictor of poor sleep quality among people with T2DM in insulin therapy<sup>[38]</sup>.

This study has some strengths and limitations. There are few studies in Iran assessing the sleep quality among people with T2DM; therefore, the results of this study can provide valuable information for clinicians in order to enhance the management of diabetes. We included a range of different variables especially psychological distress less assessed in previous studies. One limitation that could be mentioned in the present study is that the majority of study population were women (70%), so gender differences cannot be appropriately probed. The generalizability is another limitation of the present study since we recruited participants from diabetes clinic through the convenience sampling method. Although this clinic is a diabetes center, the people referring to this center might not be representative sample of entire population with diabetes. Finally, we did not collect information on caffeine intake, medications other than diabetes specific medications, and breathing disorder that might have effect on patient sleep.

In conclusion, according to the results of the present study, age, duration of disease, psychological distress and high level of cholesterol were independently associated with poor sleep quality. Therefore, promotion of diabetes management, regular primary care and psychological consultation are recommended in order to improve sleep quality among people with T2DM.

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## COMMENTS

### Background

Sleep disorder as a new risk factor for diabetes plays an important role in diabetes occurrence through neuro-metabolic pathway. Studies also reported that the high prevalence of poor sleep quality among people with type 2 diabetes mellitus (T2DM) has a negative impact on glycemic control. Research on sleep quality among diabetic people is scarce therefore, assessing a range of different socioeconomic and diabetes care factors as well as psychological

distress regarding sleep quality among people with T2DM is needed.

### Research frontiers

Diabetes is one of the health concerns in Iran due to lifestyle changes following rapid urbanization and will continue to rise in the next decades. Ardabil; a Northwestern province of Iran is among provinces, in which diabetes is very common and low quality of life and diabetes care has been reported from this area. Quality of sleep as a related factor to diabetes occurrence and control has not been assessed in this province, therefore findings of this study can provide a clearer picture of the problem in order to implement an appropriate public health interventions.

### Innovations and breakthroughs

Limited data is available on quality of life among people with diabetes in Iran and they could not find any study in Northwest of Iran where the diabetes is one of the health research priorities in this area.

### Applications

Considering the negative impact of poor quality of sleep on glycemic control among people with TD2M, identification of associated factors can contribute to promotion of diabetes management.

### Terminology

Pittsburg Sleep Quality Index (PSQI): This is a valid questionnaire evaluates 7 aspects of sleep quality including sleep quality, delay in falling asleep, sleep duration, normal quality of sleep, sleep disturbance, use of sleep medications and dysfunction during the day. Kessler psychological distress (K10): A 10-item questionnaire intended to measure the level of distress based on questions about anxiety and depressive symptoms over the recent 4 wk.

### Peer-review

Authors did a nice effort to address this important issue among Iranian population. While the results are expected, the data worth publication and will be of interest to diabetes patients.

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