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## Relationship between subjective sleep and quality of life in people with type 2 diabetes

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### Abstract

**Introduction:** Diabetic patients do not have a good quality of life. Sleep disorders and sleep quality are the factors affecting the quality of life. This study aimed to evaluate various aspects of sleep and quality of life in people with type 2 diabetes.

**Methods:** This cross-sectional study was carried out in 2015-2016 on 180 patients with type 2 diabetes presenting to endocrine clinic of Taleghani Hospital, Kermanshah University of Medical Sciences. Pittsburgh sleep quality questionnaire and quality of life SF-36 were used to collect data. SPSS 22 was used for statistical analysis.

**Results:** Subjective quality of sleep, sleep latency, sleep disturbances, sleep medications, and daily functional disorders were significantly associated with poor quality of life in people with type 2 diabetes. ( $P < 0.05$ ). Furthermore, the quality of sleep has a significant role in predicting the quality of life of patients with type 2 diabetes ( $P < 0.05$ ).

**Conclusion:** Reduced sleep quality in patients with type 2 diabetes is associated with a decline in the quality of life. Therefore, medical teams are recommended to address sleep quality in these patients.

### Introduction

Diabetes is one of the health challenges of recent decades with a large economic burden incurred on the community. Experts say that the recent outbreak of type 2 diabetes in the community has no clear relationship with changes in the genetic and ethnic characteristics of the population, but more importantly with the changes in the lifestyle of people and the modernization of society. Changing the lifestyle of people with similar genetic potentials will change the prevalence of diabetes among them and intervening in the lifestyle of people with impaired glucose tolerance is as effective as medical prevention (1). The WHO and the International Diabetes Federation consider diabetes a major challenge in primary health care in the 21st century, which is more serious in the Western Asia (2, 3). Changes in nutritional patterns, decreased physical activity and subsequent obesity are all factors that contribute to the dramatic increase in type 2 diabetes cases in the region. The WHO report, based on data from epidemiological studies in 75 regions of the 32 UN member states, shows that the prevalence of the disease in the population over the age of 20 years has increased by 64% from 1995 to 2035 in the world (4). In general, the number of people with diabetes in the world is more than 250 million cases, and it is expected to rise to 350 million in the next 17 years. The Iranian Diabetes Society reported the

diabetic population as over 2.7 million people in 2009 aged 16-68 years old (5). Considering the importance of proper blood glucose control in diabetic patients, regulating the effective factors on the proper control of blood glucose is very important. Lifestyle is one of the most important factors whose improvement can improve the care and quality of life in these patients. Sleep and rest are important components of human lifestyle and have a significant impact on individual's perception of quality of life. Various studies have reported the relationship between quality of life and sleep quality. A variety of studies have also shown the role of sleep in glucose metabolism such that the amount of glucose consumption is minimum during the NON-REM stage, maximum during being awake, and moderate during REM sleep, suggesting the effect of sleeping in diabetic patients (6, 7). Given the changes in the lifestyle of people in the 20th century, their sleep amount has reduced by 20% compared to that in the nineteenth century, which has caused more drowsiness in people during the day (8). Laboratory tests show that complete deprivation of night's sleep for 24 hours, a few days of partial night's sleep deprivation, and 12-hour of sleep for several consecutive days, all increase the resistance of peripheral tissues to insulin, impaired glucose tolerance, and increased hunger and food consumption (9, 10). In recent years, numerous epidemiological studies have been conducted on the association of the

amount and quality of night's sleep with the prevalence and incidence of diabetes. These studies reported that increasing or decreasing the duration of sleep at night was associated with an increased prevalence and incidence of diabetes and an inappropriate control of blood sugar in patients with diabetes (11). The prevalence of diabetes and impaired glucose tolerance increases with sleeping for less than 6 hours or more than 9 hours. The diabetic people have a shorter sleeping time than normal, which leads to a lower quality of life compared to other people in the community (12).

Previous studies in Iran investigated only the relationship between the duration of sleep and its effect on the quality of life of diabetic people and the relationship of different aspects of sleep (including subjective sleep quality, sleep latency, sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction) with quality of life has been studied in few studies. The design of existing studies is also contradictory, as Maracy et al. reported that sleep disorder in diabetic people is more evident than non-diabetic people (13). Ghanbari et al. showed that the duration of sleep and day-night sleep patterns are effective on the quality of life of diabetic people, as those who had a better sleep pattern reported a higher quality of life (14). Sleep disorders are often misunderstood in psychiatry and less addressed, and knowing that determining the factors affecting the quality of life of diabetic people plays an important role in the prevention and control of this fatal condition, and in promoting the health of diabetic people, the present study was designed to determine the relationship between different aspects of sleep and the quality of life of people and type 2 diabetes.

### Materials and Methods

This was a correlational cross-sectional study. The sampling method was convenience sampling. According to a similar study by Lou et al., the mean score of quality of life in diabetic patients and healthy controls was  $47.6 \pm 10.7$  and  $56.9 \pm 14.5$ , respectively (15). Assuming a 95% confidence level and 90% strength, the sample size in each group was calculated at least 45 people, but four times as this number were recruited based on the analysis of the results by the diabetes duration. A total number of 180 people were examined. The study population comprised people presenting to the endocrine clinic of Taleghani Hospital, Kermanshah University of Medical Sciences. The inclusion criteria included diabetic patients aged 25-90 years. Exclusion criteria included pregnancy and lactation, type 1 diabetes, painful diabetic neuropathies that both disrupt sleep and require medication, shift workers, thyroid problems, and those who had new other diseases during the follow-up, such as stroke, rheumatic diseases, autoimmune and cancer or taking certain medications that affected their quality of life. For each recruited person, a quality of life questionnaire (SF36) and Pittsburgh Sleep Quality Index (PSQI) were completed, body mass index and waist circumference were measured, and HbA<sub>1c</sub> test results were recorded. The questionnaires were completed at the time of admission to the endocrine clinic of Taleghani Hospital,

Kermanshah University of Medical Sciences, in order to complete the treatment. They were completed by the researcher for illiterate people. In order to minimize sample loss, the contact number of the patients and or one of their close relatives, as well as their address were recorded.

Dr. Boyce et al. developed PSQI at the Pittsburgh Psychiatric Institute in 1989. The questionnaire has 7 domains including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. It has originally 9 items, but since the 5th item contains 10 sub-items, so the whole questionnaire has 19 items that are scored on a 4-point Likert scale from 0 to 3. The validity and the reliability of the Persian version of the questionnaire were 0.86 and 0.89, respectively (16). In another study, the reliability of the questionnaire was obtained by Cronbach's alpha as 0.46 and by the half-split as 0.52 (17). A whole scale score of over 5 means poor sleep quality, and it becomes poorer as it reaches 10 (18).

Quality of life questionnaire (SF36): This self-report questionnaire, mainly used to assess the quality of life and health, was developed by Ware & Sherbourne (19) and has 36 items, and assesses 8 domains of physical functioning, social role functioning, physical role functioning, emotional role functioning, mental health, vitality, bodily pain, and general health perceptions. SF-36 also provides two overall measurements of function: the overall physical component score (PCS), which evaluates the physical dimension of health, and the overall mental component score (MCS), which evaluates the psychosocial dimension of health. The subject's score in each of these domains varies from 0 to 100, and higher scores mean a better quality of life. Reliability and validity of SF-36 have been confirmed in the Iranian population (20) and the internal consistency coefficients of the 8 subscales were between 0.70 and 0.85 and their retest coefficients with a one-week interval was 0.43 to 0.79. The questionnaire can also discriminate healthy individuals from patients in all indices (21). It should be noted that before the completion of the questionnaires, patients' oral consent was obtained for participation in the study. Also, personal information of individuals will not be referred to any centers.

This study is part of the approved thesis of the internal medicine course medicine (95679) in Kermanshah University of Medical Sciences, approved by the Ethics Committee of Research Deputy at Kermanshah University of Medical Sciences (IR.kums.REC.1394.94).

Data were analyzed using statistical tests in SPSS V.22 software. The relationship between sleep disturbance and quality of life was assessed by Kolmogorov-Smirnov test for normalization and Pearson's or Spearman's correlation coefficient (based on the results of the Kolmogorov-Smirnov test). Multivariate regression was also used for further analysis. The significance level was set as  $p < 0.05$ .

### Results

In this study, 180 type 2 diabetic patients presenting to the endocrine clinic of Taleghani Hospital,

Kermanshah University of Medical Sciences in 2015-2016 were studied. Five of them did not have the inclusion criteria. Therefore, 175 patients entered the study and were evaluated. The patients' age ranged 25-86 ( $56.02 \pm 11.68$ ) years. Among the patients, 75 (42.9%) were male and 100 (57.1%) were female. The diabetes duration was 1-32 ( $9.12 \pm 6.44$ ) years. Among the patients, 118 (67.4%) took pills, 30 (17.1%) consumed insulin, and 27 (15.4%) consumed pills and

insulin. MBI of the patients was 19-34.7 ( $25.8 \pm 2.46$ )  $\text{kg/m}^2$ . The waist circumference was 67.5-109 ( $94.42 \pm 7.69$ ) cm. Serum hemoglobin A<sup>1</sup>C was 5.5-11.9 ( $7.93 \pm 1.29$ ) mmol/mol. The descriptive characteristics of the score of the eight physical and mental dimensions of quality of life are summarized in Table 1. Descriptive characteristics of the scores of the seven dimensions of quality of sleep are summarized in Table 2.

**Table 1.** Descriptive characteristics of the score of the eight physical and mental dimensions of quality of life

Dimensions of quality of life		Minimum	Maximum	Median	Mean	Standard deviation
Physical health	Physical functioning	0	100	85	76.69	24.47
	Physical problems	0	100	75	67.63	38.81
	Bodily pain	0	100	57.5	57.98	24.3
	General health perceptions	0	100	55	48.72	27.82
	Total Physical Health Score	10	100	67.5	62.76	22.9
Mental health	Vitality	10	100	65	61.52	22.54
	Social role functioning	0	100	75	68.33	23.94
	Mental problems	0	100	66.67	71.67	31.41
	Mental health	16	96	64	61.53	18.5
	Total mental health score	17	99	68.85	65.76	19.96
Total Quality of Life Score		14.42	98.25	64.26	65.78	19.83

**Table 2.** Descriptive characteristics of the score of the seven physical and mental dimensions of quality of sleep

Dimensions of sleep quality	Minimum	Maximum	Median	Mean	Standard deviation
subjective sleep quality	0	3	2	1.58	1.05
Sleep latency	0	3	2	1.57	1.14
Sleep duration	0	2	0	2.08	0.93
Sleep efficiency	0	1	0	0.061	0.24
Sleep disturbances	0	3	2	1.61	0.58
Use of sleeping medications	0	3	0	0.65	1.14
Daytime dysfunction	0	3	1	1.05	0.88
Total sleep quality score	1	17	9	8.63	3.49

Based on the results of Table 3, no significant relationship was observed between domains of the quality of sleep including sleep duration, sleep efficiency and total sleep quality score, and the quality of life in type 2 diabetic patients with diabetes duration of  $\leq 5$  years ( $P > 0.05$ ). Subjective sleep quality, sleep latency, sleep disturbances, use of sleeping medications, and daytime dysfunction were significantly associated with a decline in quality of life in people with type 2 diabetes with diabetes duration of  $\leq 5$  years ( $P < 0.05$ ). There was no significant relationship between the quality of sleep domains of sleep duration and sleep efficiency with quality of life in people with type 2

diabetes with duration diabetes of over 5 years ( $P > 0.05$ ). Subjective sleep quality, sleep latency, sleep disturbances, use of sleeping medications and daytime dysfunction were significantly associated with a decline in quality of life in people with type 2 diabetes with a diabetes duration of  $> 5$  years ( $P < 0.05$ ). Overall, there was no significant relationship between sleep quality domains of sleep duration and quality of life in people with type 2 diabetes ( $P > 0.05$ ). Subjective sleep quality, sleep latency, sleep disturbances, use of sleeping medications, and daytime dysfunction were significantly associated with a decline in quality of life in people with type 2 diabetes ( $P < 0.05$ ).

**Table 3.** Correlation coefficient and relationship between different domains of sleep and quality of life in people with type 2 diabetes

Dimensions of quality of life	Diabetes duration	Subjective sleep quality	Sleep latency	Sleep duration	Sleep efficiency	Sleep disturbances	Use of sleeping medications	Daytime dysfunction	Total sleep quality score
Total	$\leq 5$	-0.56**	-0.377**	0.033	0.223	-0.287*	-0.14**	-0.515**	-0.056
Physical Health Score	$> 5$	-0.469**	-0.346**	0.023	0.015	0.498**	-0.277**	-0.486**	-0.559**
	Total	-0.501**	-0.394**	-0.018	0.095	0.45**	-0.292**	-0.505**	-0.576**
Total mental health score	$\leq 5$	-0.691**	-0.522**	-0.009	0.135	-0.245	-0.497**	-0.683**	-0.368**
	5	-0.405**	-0.319**	0.038	-0.043	-0.455**	-0.336**	-0.525**	-0.553**
	Total	-0.511**	-0.4**	0.0001	0.031	-0.407**	-0.393**	-0.577**	-0.625**
Total Quality of Life Score	5	-0.688**	-0.495**	-0.022	0.192	-0.288**	-0.36**	-0.659**	-0.243
	$> 5$	-0.473**	-0.359**	0.032	-0.011	-0.515**	-0.326**	-0.541**	-0.598**
	Total	-0.554**	-0.43**	0.008	0.063	-0.462**	-0.371*	-0.584**	-0.647**

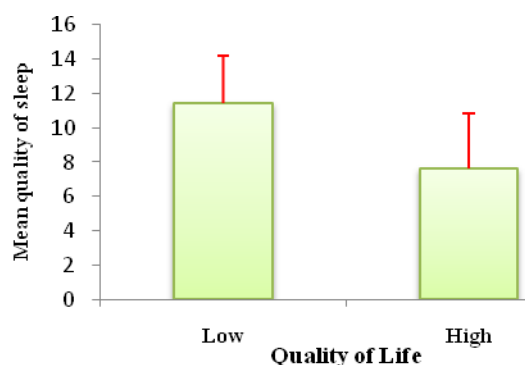
\*: Significant at 0.05 level. \*\*: Significant at 0.01 level.

According to Table 4, estimating the coefficients of predictor variables in multivariate logistic regression analysis of quality of life in patients with type 2 diabetes showed that the diabetes duration and sleep quality

variables were statistically significant ( $P < 0.05$ ). In fact, these two factors together had a statistically significant contribution to correctly predict the quality of life of patients with type 2 diabetes (Figure 1).

**Table 4.** Multivariate logistic regression analysis of predictive factors of quality of life in people with type 2 diabetes

Feature	Coefficient	SD	Significance level	Odds Ratio	95% confidence interval
Age	0.015	0.016	0.366	1.015	0.983 - 1.048
Sex	0.2	0.407	0.624	1.22	0.549 - 2.714
Diabetes duration	-0.07	0.035	0.044	0.93	0.87 - 0.998
Consumed medicine	0.727	0.491	0.139	2.068	0.791 - 5.41
A <sup>1</sup> C	-0.237	0.156	0.128	0.789	0.58 - 1.071
BMI	0.237	0.136	0.082	1.267	0.971 - 1.65
Waist circumference	-0.01	0.035	0.772	0.99	0.923 - 1.06
Sleep quality	-0.384	0.074	<0.001	0.681	0.589 - 0.787



**Figure 1.** Mean quality of sleep in terms of quality of life in type 2 diabetic patients

## Discussion

According to the most important results of this study, the quality of life of people with type 2 diabetes decreases with the decrease in sleep quality. This result is consistent with the results of previous studies (24-33). Evidence suggests that diabetes and sleep disorders are associated with a decline in quality of life, diabetes self-care behaviors, and outcomes of the disease (22, 22). However, we did not observe a relationship between the variables of sleep duration and sleep efficiency and the quality of life of people with type 2 diabetes, while subjective sleep quality, sleep latency, sleep disturbances, use of sleeping medications, and daytime dysfunction had a relationship with quality of life in people with type 2 diabetes. Torabi et al. (2014), consistent with the present study, found that, among sleep quality domains, sleep duration had no relationship with quality of life of people with type 2 diabetes, while sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction had a relationship with the quality of life of people with type 2 diabetes. However, inconsistent with this study, they found that subjective sleep quality and sleep latency had no relationship with the quality of life of people with type 2 diabetes. This discrepancy can be attributed to age and gender differences of the subjects (25). Vieira et al. (2008), in line with this study, found that there was an inverse relationship between all aspects of sleep quality, except for sleep duration, and quality of life in type 2 diabetic patients (27). Saadi et al. (2017) had results inconsistent with the present study and reported that sleep quality and domains of sleep duration and use of sleeping medications had a relationship with the quality

of life of women with gestational diabetes. This discrepancy can be due to the difference in the samples of the two studies. However, they had consistent results, too, reporting that sleep quality and its other domains had a relationship with quality of life of women with gestational diabetes (33).

In the present study, the diabetes duration and sleep quality together predicted the quality of life of patients with type 2 diabetes such that sleep quality of people with type 2 diabetes with diabetes duration  $\leq 5$  years had no relationship with quality of life. Although, the quality of life of people with type 2 diabetes with a duration of diabetes of  $>5$  years decreased with a decrease in sleep quality. Based on our literature review, we did not find any studies on the relationship between sleep quality and quality of life in diabetic patients regarding the diabetes duration, which is one of the limitations of the present study, and we cannot compare it with other studies.

Diabetes is one of the most common metabolic diseases with an adverse effect on the dimensions of patients' lives and has no cure. Quality of life is the most important indicator for assessing the health care status of chronic diseases (34). However, what is clear is that diabetes reduces the sensory and motor capabilities and increases the stress of patients and exacerbates their mental and physical problems over time. Therefore, using methods that can reduce these complications can help improve their quality of life (35). Furthermore, sleep quality is the most important indicator for assessing the health care status of chronic diseases, including diabetes (36). Sleep and the immune system are associated with the pathological status of diabetic patients (37). Sleep disturbance in diabetic patients compromises the immune system (38) and clear evidence suggests that sleep has a direct impact on the central nervous system in diabetic patients (39). Therefore, improved sleep quality can affect the general physical health by improving the compatibility of the nervous system, immune system, autoimmune modulation, and increasing physical stability, body resistance, and immunomodulation, and when the patients feel healthy, it can affect all aspects of their life and improve their quality of life (40). Therefore, improving the quality of sleep as a variation in the course of the disease can be used to treat diabetic patients because it will strengthen physical and mental health resulting in improved quality of life of patients and their satisfaction with life.

Biological mechanism of the relationship between sleep quality and quality of life in diabetic patients has not been studied in previous studies. However, poor sleep quality stimulates the central system to secrete large amounts of catecholamine, which increases blood glucose and, consequently, decreases the quality of life (30).

One of the strengths of this study was examining the relationship between all aspects of sleep quality and quality of life in type 2 diabetic patients and assessment according to the diabetes duration. However, few studies have reported it, limiting the possibility of comparing the present study with other studies. However, this study had some limitations, including: first, this was a cross-sectional study, therefore, it is suggested that a prospective study be designed to evaluate the effect of sleep quality on the status of factors affecting the quality of life of diabetic patients in the long run. Furthermore, a cross-sectional study cannot explain a causal relationship. Second, quality of sleep and quality of life were self-reported and not directly measured. Therefore, patient cooperation in this area can be a confounding factor. Third, this study did not have a control group of people without diabetes. A control group could give us better results, but our results are related to only diabetes. Therefore, it is recommended to consider this issue in later studies. Despite this, the results of the study are still valid. Fourth, given the fact that it was not possible to accurately measure all independent variables affecting the quality of sleep and quality of life, hence it is suggested that other studies address other variables such

as habits, income, education, nutrition, functional status, psychological syndromes and daily life stress. Also, depression is a disorder associated with diabetes, which affects both the quality of sleep and quality of life, and this study did not investigate the state of depression in patients. Therefore, it should be noted that this questions the reliability of the results, and it is suggested that this problem be considered in further studies.

### Conclusion

According to the results of the present study, the quality of life decreased with a decrease in the quality of sleep in type 2 diabetic patients. Furthermore, two factors of sleep quality and diabetes duration were identified as predictors of quality of life in type 2 diabetic patients. Therefore, we recommend physicians to assess the quality of sleep in addition to other treatments and, if necessary, take measures to improve sleep quality.

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### References

- Joshi SK, Shrestha S. Diabetes mellitus: a review of its associations with different environmental factors. *Kathmandu Univ Med J (KUMJ)*. 2010;8(29):109-15.
- Trasoff D, Delizo J, Du B, Purnajo C, Morales J. Diabetes in the Middle East. *Epinex Diagnostics Inc (EPI)*. Available from: URL: <http://www.epinex.com/index.php>.
- International Diabetes Federation (IDF). Diabetes prevalence. Available from: URL: <http://www.diabetesatlas.org/>.
- Whiting DR, Guariguata L, Weil C, Shaw J. IDF diabetes atlas: global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes research and clinical practice*. 2011 Dec 31;94(3):311-21.
- Iranian Diabetes Society (IDS). Payame Diabet (Scientific- Educational Quarterly) 2001; 4: [Farsi]. Available from: URL: [http://journals.tums.ac.ir/upload\\_files/pdf/15455.pdf](http://journals.tums.ac.ir/upload_files/pdf/15455.pdf)
- Larijani B, Zahedi F, and Aghakhani Sh. Epidemiology of diabetes mellitus in Iran. *Shiraz E-Medical Journal* October 2003; 4(4). Available from: URL: <http://pearl.sums.ac.ir/semj/vo14/oct2003/DMinIran.htm>
- International Diabetes Federation (IDF). Diabetes Atlas. Prevalence estimates of diabetes 20-70 years, 2007 (adjusted to world population). Available from: URL: <http://www.eatlas.idf.org/atlasff5d.html>.
- Mensink M, Blaak EE, Corpeleijn E, Saris WH, de Bruin TW, Feskens EJ. Lifestyle intervention according to general recommendations improves glucose tolerance. *Obes Res*. 2003; 11(12):1588-96.
- Knutson KL. Impact of sleep and sleep loss on glucose homeostasis and appetite regulation. *Sleep Med Clin* 2007; 2(2): 187-97.
- Spiegel K, Knutson K, Leproult R, Tasali E, Van Cauter E. Sleep loss: a novel risk factor for insulin resistance and Type 2 diabetes. *J Appl Physiol* (1985). 2005;99(5):2008-19.
- Nakajima H, Kaneita Y, Yokoyama E, Harano S, Tamaki T, Ibuka E, et al. Association between sleep duration and hemoglobin A1C level. *Sleep Med*. 2008;9(7):745-52
- Gottlieb DJ, Punjabi NM, Newman AB, Resnick HE, Redline S, Baldwin CM, et al. Association of sleep time with diabetes mellitus and impaired glucose tolerance. *Arch Intern Med*. 2005;165(8):863-7.
- Maracy M R, Amini M, Kheirabadi G R, Fakhari M, Fakhari N, Zonnari R. Comparison of Night Time Sleep Quality in Type 2 Diabetics, Impaired Glucose Tolerance Cases and Non-Diabetics . *Iranian Journal of Endocrinology and Metabolism*. 2011; 13(2) :165-72.
- Ghanbari A, Yekta ZP, Roushan ZA, Lakeh NM. Assessment of factors affecting QoL in diabetic patients in Iran. *Public Health Nurs*. 2005;22(4):311-22.
- Lou P, Qin Y, Zhang P, Chen P, Zhang L, Chang G, Li T, Qiao C, Zhang N. Association of sleep quality and quality of life in type 2 diabetes mellitus: A cross-sectional study in China. *Diabetes Research and Clinical Practice*. 2015;107(1):69-76.
- Heydari AR, Ehtesham zadeh P, Marashi M. The relationship between insomnia severity, sleep quality, sleepiness and impaired mental health and academic performance in girls. *Women and Culture*. 2011;1(40):65-76.
- Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Research*. 1989;28(2):193-213.

18. Farrahi J, Nakhaee N, Sheibani V, Garrusi B, Amirkaifi A. Psychometric properties of the Persian version of the Pittsburgh Sleep Quality Index addendum for PTSD (PSQI-A). *Sleep Breath*. 2009;13(3):259-62.
19. Ware JE, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36). I. Conceptual framework and item selection. *Med Care*. 1992;30(6):473-83.
20. Montazeri A, Goshtasebi A, Vahdaninia M, Gandek B. The short form Health Survey (SF-36): Translation and validation study of the Iranian version. *Qual Life Res*. 2005;14(3):875-82.
21. Rafiei N, Sharifian Sani M, Rafiey H, Behnampour N, Foroozesh K. Reliability and validity of Persian version of Quality of Life Index (QLI) questionnaire. *Journal of Mazandaran University of Medical Sciences*. 2014;24(116):75-83.
22. Ohayon MM, Reynolds CF, Dauvilliers Y. The link between excessive quantity of sleep and deteriorated quality of wakefulness-implications for the DSMZ-5. *Ann Neurol*. 2013;73(6):785-94.
23. Chasens ER, Luyster FS. Effect of sleep disturbances on quality of life, diabetes self-care behavior, and patient-reported outcomes. *Diabetes Spectr*. 2016;29(1):20-3.
24. Torabi M, Izadi A, Naderi far M, Shamsaei F. Sleep Quality and Quality of Life in Adults with Type 2 Diabetes. *J Diabetes Nurs*. 2014; 2 (1) :51-61
25. Luyster FS, Dunbar-Jacob J. Sleep quality and quality of life in adults with type 2 diabetes. *Diabetes Educ*. 2011;37(3):347-55
26. Ahmadi A, Hasanzadeh J, Rahimi M, Lashkari L. Effective factors in the quality of life of patients with type 2 diabetes in Chaharmahal & Bakhteyari province. *Journal of North Khorasan University of Medical sciences*. 2011;3(1):7-13.
27. Vieira V, Verussa T, Lagacci M, Ueno M, Cocetti M, Ceolim M, et al. Quality of sleep and quality of life in people with type 2 diabetes. *Journal of Diabetes Nursing*. 2008 1;12(7):262-70.
28. Lou P, Qin Y, Zhang P, Chen P, Zhang L, Chang G, et al. Association of sleep quality and quality of life in type 2 diabetes mellitus: A cross-sectional study in China. *Diabetes Res Clin Pract*. 2015;107(1):69-76.
29. Zhang P, Lou P, Chang G, Chen P, Zhang L, Li T, Qiao C. Combined effects of sleep quality and depression on quality of life in patients with type 2 diabetes. *BMC Fam Pract*. 2016; 17:40.
30. Zhao J, Li XL, Han K, Tao ZQ, Wu ZM. Biological interaction between sleep quality and depression in type 2 diabetes. *Eur Rev Med Pharmacol Sci*. 2016;20(14):3087-91.
31. Chasens ER, Sereika SM, Burke LE, Strollo PJ, Korytkowski M. Sleep, health-related quality of life, and functional outcomes in adults with diabetes. *Appl Nurs Res*. 2014;27(4):237-41.
32. Seligowski AV, Pless Kaiser AP, Niles BL, Mori DL, King LA, King DW. Sleep quality as a potential mediator between psychological distress and diabetes quality of life in veterans with type 2 diabetes. *J Clin Psychol*. 2013;69(10):1121-31.
33. Saadati F, Sehhatiei Shafaei F, Mirghafourvand M. Sleep quality and its relationship with quality of life among high-risk pregnant women (gestational diabetes and hypertension). *J Matern Fetal Neonatal Med*. 2018;31(2):150-7.
34. Johari N, Manaf ZA, Ibrahim N, Shahar S, Mustafa N. Predictors of quality of life among hospitalized geriatric patients with diabetes mellitus upon discharge. *Clin Interv Aging*. 2016;11:1455-61.
35. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Quantity and quality of sleep and incidence of type 2 diabetes a systematic review and meta-analysis. *Diabetes Care*. 2010;33(2):414-20.
36. Pickup JC. Inflammation and activated innate immunity in the pathogenesis of type 2 diabetes. *Diabetes care*. 2004;27(3):813-23.
37. Tsujimura T, Matsuo Y, Keyaki T, Sakurada K, Imanishi J. Correlations of sleep disturbance with the immune system in type 2 diabetes mellitus. *Diabetes Res Clin Pract*. 2009;85(3):286-92.
38. Dijk DJ. Slow-wave sleep, diabetes, and the sympathetic nervous system. *Proc Natl Acad Sci U S A*. 2008;105(4):1107-8
39. Lorton D, Lubahn CL, Estus C, Millar BA, Carter JL, Wood CA, et al. Bidirectional communication between the brain and the immune system: implications for physiological sleep and disorders with disrupted sleep. *Neuroimmunomodulation*. 2006;13(5-6):357-74.
40. Asadi-Lari M, Tamburini M, Gray D. Patients' needs, satisfaction, and health related quality of life: Towards a comprehensive model. *Health Qual Life Outcomes*. 2004; 2(32):1-15.