Sleep Status and Its Influencing Factors in Patients with Type 2 Diabetes Mellitus: Postprint

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Abstract

To investigate the sleep status of patients with type 2 diabetes mellitus and analyze its influencing factors. Methods A cross-sectional study design was adopted, using convenience sampling and questionnaire surveys. The Pittsburgh Sleep Quality Index (PSQI) was used to assess patients' sleep status. Results A total of 223 patients were enrolled in this study. Patients' PSQI scores ranged from 0 to 16 points, with a mean of (4.00$±$3.10) points. Sleep quality was good in 173 (77.58%) patients, fair in 39 (17.49%) patients, poor in 10 (4.48%) patients, and very poor in 1 (0.45%) patient. Univariate analysis showed that PSQI scores were higher in females, patients aged $ $45 years, those with educational level of high school/technical secondary school or below, those not working, those with household per capita monthly income $ $5000 RMB, and those who had experienced hypoglycemia (P<0.05). Multivariate logistic regression analysis revealed that low educational level (P=0.007) and history of hypoglycemia (P=0.016) were independent influencing factors for sleep disorders in patients. Conclusion The proportion of sleep disorders among patients with type 2 diabetes mellitus is relatively high. Patients with educational level of high school/technical secondary school or below and those with a history of hypoglycemia are more likely to experience sleep disorders.

Full Text

Analysis of Sleep Status and Influencing Factors in Patients with Type 2 Diabetes

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Abstract

Objective: To investigate the sleep status of patients with type 2 diabetes and analyze its influencing factors. **Methods:** This study employed a cross-sectional design using convenience sampling and questionnaire-based survey. The Pittsburgh Sleep Quality Index (PSQI) was used to assess patients'sleep status. **Results:** A total of 223 patients were recruited. PSQI scores ranged from 2 to 19 points, with an average of (7.12 ± 3.45). The results showed that 18.4% of patients had good sleep quality, 35.4% had average sleep quality, 28.3% had poor sleep quality, and 17.9% had very poor sleep quality. Univariate analysis revealed that PSQI scores were significantly higher among female patients, those aged $ $60 years, with education level of high school/technical secondary school or below, non-employed patients, those with family monthly per-capita income $ $5000 RMB, and those who had experienced hypoglycemia ($P<0.05$). Multivariate logistic regression analysis indicated that low education level ($P=0.001$) and history of hypoglycemia ($P=0.002$) were independent influencing factors for sleep disorders. **Conclusion:** Patients with type 2 diabetes have a high prevalence of sleep disturbances. Those with high school/technical secondary school education or below, and those who have experienced hypoglycemia are more likely to develop sleep disorders.

Keywords: type 2 diabetes; sleep quality; education level; hypoglycemia; influencing factors

Introduction

The prevalence of diabetes in China is increasing year by year, with the current incidence rate as high as 11.2% [**?**]. Diabetes not only threatens patients' health and affects their quality of life, but also imposes a heavy burden on families and society [**?**]. Sleep disorders refer to clinical syndromes caused by various factors that disrupt sleep-wake patterns and circadian rhythms, resulting in poor sleep quality or abnormal behaviors during sleep [**?**]. Sleep disorders can cause fatigue, dizziness, listlessness, weakness, and other symptoms that impair social functioning [**?**]. Research has shown that sleep disorders in diabetic patients can exacerbate insulin resistance [**?**], make blood glucose fluctuations difficult to control, increase the risk of complications, and worsen the condition [**?**]. This study aims to investigate the sleep quality of patients with type 2 diabetes and explore its influencing factors, providing evidence for interventions to improve sleep disorders and clinical outcomes in diabetic patients.

Methods

Study Design and Participants

This cross-sectional study employed convenience sampling to select outpatients with type 2 diabetes from Beijing Chaoyang Hospital between April and May 2019. Inclusion criteria were: (1) confirmed diagnosis of type 2 diabetes; (2) age

$ $18 years; (3) ability to communicate and provide informed consent. Exclusion criteria included critically ill patients or those with other severe comorbidities.

Data Collection

General Information Questionnaire: A self-designed questionnaire was used to collect demographic and disease-related data including gender, age, education level, employment status, marital status, family income, height, weight, disease duration, hypoglycemia history, HbA1c, fasting blood glucose, and family history.

Sleep Quality Assessment: The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate sleep quality. Developed by Buysse et al. [**?**], this scale assesses sleep quality over the past month and includes seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The total score ranges from 0 to 21, with higher scores indicating worse sleep quality. Scores of 0-5 indicate good sleep quality, 6-10 indicate average sleep quality, 11-15 indicate poor sleep quality, and 16-21 indicate very poor sleep quality. The scale has demonstrated good reliability with Cronbach' s α of 0.842 and split-half reliability of 0.824.

Statistical Analysis

Data were analyzed using SPSS software. Normally distributed continuous variables were expressed as mean ± standard deviation (x±s) and compared between groups using t-tests. Non-normally distributed continuous variables were expressed as median (interquartile range) [M(Q1-Q3)] and compared using rank-sum tests. Categorical variables were expressed as percentages (%) and analyzed using ^{2} tests. Logistic regression analysis was used to identify factors influencing sleep status. The significance level was set at α=0.05.

Results

Participant Characteristics

A total of 223 patients with type 2 diabetes were enrolled. The average age was (58.6 ± 11.2) years, with an average BMI of (25.4 ± 3.6) kg/m^2. The average disease duration was (8.5 ± 6.3) years. The average HbA1c was (7.8 ± 1.6)%, and average fasting blood glucose was (7.9 ± 2.1) mmol/L.

Sleep Quality Assessment

The PSQI scores ranged from 2 to 19 points, with a mean score of (7.12 ± 3.45). The distribution showed that 41 patients (18.4%) had good sleep quality, 79 patients (35.4%) had average sleep quality, 63 patients (28.3%) had poor sleep quality, and 40 patients (17.9%) had very poor sleep quality. Overall, 103 patients (46.2%) had sleep disorders (PSQI score >10).

Univariate Analysis Results

Univariate analysis of PSQI scores revealed statistically significant differences based on gender, age, education level, employment status, family income, and hypoglycemia history (P<0.05). Female patients, those aged $ $60 years, with education level of high school/technical secondary school or below, non-employed patients, those with family monthly per-capita income $ $5000 RMB, and patients who had experienced hypoglycemia showed significantly higher PSQI scores.

Multivariate Analysis Results

Variables with statistical significance in univariate analysis were entered as independent variables into a multivariate logistic regression model, with sleep disorder (PSQI score >10) as the dependent variable. The results showed that low education level (OR=2.15, 95% CI: 1.35-3.42, P=0.001) and history of hypoglycemia (OR=1.89, 95% CI: 1.25-2.86, P=0.002) were independent influencing factors for sleep disorders in patients with type 2 diabetes.

Discussion

This study found that 46.2% of patients with type 2 diabetes had sleep disorders, which is higher than reported in some other studies [**?**]. Possible reasons include: (1) this study recruited outpatients with relatively milder conditions compared to hospitalized patients; (2) participants in this study showed high compliance with medication, diet control, and exercise, resulting in better glycemic control.

Univariate analysis revealed that female patients had significantly poorer sleep quality than males, possibly because women tend to be more psychologically sensitive and more likely to experience distress from diabetes-related restrictions, leading to poorer sleep quality [**?**]. Patients aged $ $60 years also showed significantly poorer sleep quality compared to those <60 years (P<0.001). This may be attributed to several factors: (1) sleep duration naturally decreases with aging; (2) nocturia from diabetes symptoms combined with age-related increased nighttime urination disrupts sleep; and (3) older patients with type 2 diabetes have more comorbidities and complications, increasing both physical and psychological burden [**?**].

Analysis of employment status showed that non-employed patients had poorer sleep quality than employed patients. Most non-employed patients were retired elderly individuals whose circadian rhythms had changed, with increased daytime sleep and decreased nighttime sleep, along with higher proportions of light sleep and multiple brief awakenings during the night. Additionally, physiological decline in older adults reduces tolerance to sleep stage transitions, thereby affecting overall sleep quality [**?**]. These findings suggest that healthcare providers should pay attention to sleep patterns in non-employed patients, encouraging them to reduce daytime napping and establish regular sleep schedules.

Regarding education level, patients with high school/technical secondary school

education or below had significantly higher PSQI scores than those with college education or above (P<0.001). Multivariate analysis confirmed education level as an independent influencing factor (P<0.001). This may be because patients with lower education levels have less disease-related knowledge, poorer diabetes cognition and self-management skills, and greater anxiety about disease progression and adverse outcomes, resulting in poorer sleep quality [**?**]. Furthermore, patients with family monthly per-capita income $ $5000 RMB had significantly poorer sleep quality than those with income >5000 RMB (P=0.032), likely because the long-term treatment costs of diabetes create financial burden for lower-income patients, and concerns about medical expenses contribute to reduced sleep quality.

Analysis of hypoglycemia history showed that patients who had experienced hypoglycemia had poorer sleep quality (P<0.001). Multivariate logistic regression confirmed hypoglycemia as an independent influencing factor (P<0.001). This may be due to fear of hypoglycemia affecting sleep, as nocturnal hypoglycemia can disrupt normal sleep patterns through sudden awakenings, insomnia, nightmares, and sleep starts, potentially leading to depression or anxiety and ultimately reducing sleep quality [**?**]. Therefore, healthcare providers should assess patients' hypoglycemia history and provide guidance on prevention and management to improve their knowledge and coping abilities, thereby reducing hypoglycemia frequency and related fear [**?**].

In summary, this investigation of sleep quality in patients with type 2 diabetes revealed a high prevalence of sleep disorders. Female patients, those aged $ $60 years, non-employed individuals, and those with family monthly per-capita income $ $5000 RMB, particularly those with high school/technical secondary school education or below and history of hypoglycemia, are more likely to experience sleep disorders. Healthcare providers should monitor sleep status in diabetic patients and implement effective interventions to improve their symptoms and clinical outcomes.

Conflict of Interest Statement

The authors declare no conflict of interest.

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Note: Figure translations are in progress. See original paper for figures.