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Orginal Article

Sleep quality and its impact on glycaemic control in patients with type 2 diabetes mellitus

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ABSTRACT

Purpose: To investigate the sleep quality of patients with type 2 diabetes (T2D) and its impact on glycaemic control.

Methods: Using a convenience sampling method, 220 patients with T2D were recruited. The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate the sleep quality with threshold at PSQI $\geq$ 8. The glycosylated haemoglobin A1c (HbA1c) test was used to measure the glycaemic control with threshold at HbA1c < 7%.

Results: The PSQI score was 8.30 ± 4.12. The sleep disorder incidence rate was 47.1%. Patients with HbA1c $\geq$ 7% had significantly lower PSQI global and factor scores ($p < 0.01$) versus the control group. Sleep latency, sleep disturbance, and daytime dysfunction were the risk factors for poor glycaemic control.

Conclusion: Patients with T2D have high sleep disorder rate negatively impacting glycaemic control. Health care providers should pay close attention to the sleep quality of T2D patients, and provide them with appropriate educational material.

1. Introduction

Diabetes mellitus is a common metabolic disease. By year 2035, it estimated that 592 million people across the world will live with diabetes [1]. Type 2 diabetes currently accounts for 95% of all of diagnosed diabetes [2]. In China, the incidence of diabetes is high at 9.75% [3], exerting vast burden on the individuals, families, and society [4]. Multiple studies have recognized sleep disorder a novel risk factor for diabetes [5,6]. The sleep disorder plays a pivotal role in the occurrence and development of diabetes via neuro – endocrine metabolic pathway [7]. People suffering from a sleep disorder – sleep quality or sleep quantity are impaired – experience reduction in the insulin sensitivity and consequently, elevated blood glucose, aggravating the progress of diabetes. On the other hand, sleep disorder can facilitate the hypothalamic–pituitary–adrenocortical system to release extra glucocorticoid. As a result, the glucose production increases, while the consumption decreases, affecting the glycaemic control [8,9]. Therefore, good sleep quality is crucial for maintaining an effective glycaemic control and improving the

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quality of life of patients with diabetes. Nevertheless, the majority of the current sleep studies in diabetic patients focus on obstructive sleep respiratory disease. Some studies deployed complex evaluation methods which are difficult to use pervasively in practice. Furthermore, there have been only a few domestic studies addressing the role of sleep disorder in diabetic patients, and their generalization has been restricted due to the singleness of subjects, who were either senior citizens or females. The aim of our study was to reveal further evidence verifying the relationship between sleep and glycaemic control. The sleep quality and its impact on glycaemic control in patients with type 2 diabetes were analysed, thereby laying foundation for corresponding interventions in practice.

2. Subjects and methods

2.1. Subjects

A total of 220 patients was administered in the Department of Endocrinology in the 1st and 2nd Affiliated Hospital of Xi'an Jiaotong University during September, 2013 and January, 2014. Participants were selected using convenience sampling method, and the sample size was determined using the observational study formulae [10]. The inclusion criteria were: a) meet the diagnostic criteria for type 2 diabetes (symptoms of diabetes + fasting plasma glucose (FPG) $\geq$ 7.0 mmol/L) [11], b) symptoms of diabetes and 2 h postprandial plasma glucose (2hPG) $\geq$ 11.1 mmol/L, c) symptoms of diabetes and random plasma glucose $\geq$ 11.1 mmol/L, d) over 18 years old with diabetes duration > 1 year. Patients were excluded if they had type 1 diabetes, gestational diabetes, or other specific types of diabetes, as were the patients with acute diabetic complications, severe heart diseases, lung diseases, and cerebral diseases. Those with mental illness or family history of mental illness, and those with intelligence or cognitive impairment were also excluded from this study.

2.2. Study tools

2.2.1. General information questionnaire

Using literature search, clinical and research experts, a questionnaire was developed, modified, and improved. Participants' demographic information such as gender, age, education, marital status, and life style (smoking, drinking and exercise) were evaluated. Additionally, data on chronic diabetic complications and family history were collected to assess their disease status. Physiological and biochemical indicators such as HbA1c and body mass index (BMI) were obtained using this questionnaire.

2.2.2. Pittsburgh sleep quality index (PSQI)

PSQI is a self-rating scale developed by Buysse et al., in 1989 [12]. The scale was translated into Chinese by Xian-Chen Liu to evaluate the sleep quality. A total of 19 self-rating items were categorized into seven factors, all subjective, sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction. Each factor was scored from 0 to 3. The sum of the scores for the seven factors yields PSQI global score, which ranges from 0 to 21. Higher the PSQI global score, poorer the sleep quality. PSQI has been used widely in multiple populations, and has shown a good internal consistency, test-retest reliability, construct validity, and empirical validity. In a study carried out by Xian-Chen Liu [13], the Cronbach'α coefficient of PSQI was 0.84, the split half reliability was 0.87, and a 2-week test-retest reliability was 0.81. The cut-off PSQI score was $\geq$8, the sensitivity was 98.3%, and the specificity was 90.2%. Therefore, PSQI $\geq$8 was used as an indication of the presence of sleep disorder in this study.

2.3. Data collection

The study protocol was approved by the Ethics Committee of the Xi'an Jiaotong University and was conducted in accordance with the Declaration of Helsinki. All participants provided a written informed consent.

2.3.1. Questionnaires

A total of 220 questionnaires were handed out. Systematically trained investigators carried out unified interviews. The face-to-face interviews and the questionnaires were completed independently by the participants per se. The participants unable to complete the questionnaire by themselves were asked item by item orally by the investigators. The investigators recorded the answers truthfully. If any questions arose during the interview, the investigators provided an explanation or clarification to a participant. Once completed the questionnaires were recovered. Any missing parts were supplemented by the patients to ensure the consistent data quality.

2.3.2. Physiological and biochemical indicators

Participants' height, weight, and blood pressure were measured on the first day of being admitted. The HbA1c level (using high pressure liquid chromatography) and liver function were evaluated under fasting state for at least 10 h. Parameters reflecting liver function such as total cholesterol (TC), triglyceride (TG), high density lipoprotein cholesterol (HDL-C), and low density lipoprotein cholesterol (LDL-C) were measured using the ADVIA® 2400 automatic biochemical analyser (Siemens, Berlin, Germany). The fingertip blood samples were collected to assess FPG and 2hPG (OneTouch® UltraVue, Johnson, America). According to the American Diabetes Association guidelines for 2010 [14], HbA1c < 7% is considered to be a good glycaemic control.

2.4. Statistical analysis

Data were managed using Epi Info 7 software and double entry method was used to ensure the quality. Statistical analysis was conducted using SPSS version 13.0 software (SPSS Inc., Chicago, IL, USA). Frequency, percentage, and mean ± standard deviation were used for statistical description. The independent-samples t test, nonparametric Mann–Whitney U-test, and χ^2 test were performed for statistical inference. Finally, a logistic regression model was established, using PSQI factor scores as independent variables and HbA1c as dependent variables. Values of $p < 0.05$ were considered statistically significant.