Review Article

Diabetes and daytime sleeping: systematic review

Abstract:

Background: The relationship between sleep disturbance and diabetes is dual-sided. Chronic sleep disturbances would elevate the risk of developing insulin resistance, while diabetes would worsen the quality of sleep. **Objective:** to address the aspects of insufficient sleep, diabetes mellitus, and their mutual interactions and interlinkages. The main objectives is to address the role and effect of diabetes on sleep. Methods: systematic review. A systematic search was done in PubMed, MEDLINE through Clarivate, Web of Science through Clarivate, and EBSCO. Studies retrieved were managed in Rayyan– Intelligent systematic reviews website for duplicate removal and screening. **Result:** DM is one of the most common diseases worldwide. DM, in addition to causing direct sleep disturbances as a result of nocturia, polyuria, diabetic neuropathy and neuropathy pain, has also been associated with several chronic illness as obstructive sleep apnea, cardiovascular complications, hypertension, cerebrovascular accidents and depression which can impair sleep and quality of life. The patient may not bring the sleep issues during their visit to healthcare providers, with acute issues taking precedence during their visit.**Conclusion**: DM causes night sleep disturbances which eventually leads to daytime sleeping. Sleep education should be considered an essential part in the diabetic management armamentarium.

Keywords: Diabetes mellitus, Sleep quality, Quality of life, Sleep disturbance, Nocturnal hypoglycemia.

Introduction:

Diabetes mellitus is defined by chronic hyperglycemia caused by a malfunction in carbohydrate, lipid, and protein metabolism. (1) Type 2 diabetes mellitus (T2DM) is the most common type of diabetes, accounting for 90% of cases and impacting over 460 million people worldwide, with forecasts predicting an increase to over 700 million in only 25 years. T2DM is primarily caused by insulin resistance in skeletal muscle, liver, and adipose tissue, which finally leads to pancreatic -cell dysfunction and failure. (2) These deficiencies lead to a chronic hyperglycemic condition, which, if addressed, can lead to significant consequences such as macrovascular and microvascular illness. Over

the last century, there has been an inverse fall in sleep duration, mirroring the secular rise in T2DM(3)

Sleep is important for regulating many physiologic functions that relate to metabolism. Because of this, there is substantial evidence to suggest that sleep habits and sleep disorders are related to diabetes risk. (4)

Sleep deprivation and diabetes have a two-way link. Chronic sleep disruption increases the risk of developing insulin resistance, while diabetes reduces sleep quality. Sleep disruptions, both qualitative and quantitative, considerably increase the chance of acquiring diabetes. When considering the quantitative element, it should be noted that both short and long durations of sleep are related with a higher prevalence of diabetes, with 7-8 h per day posing the lowest risk, albeit the underlying mechanisms and causes in both scenarios may differ. (5)

Sleep disturbances are substantially more common in diabetics than in individuals without diabetes. Multiple factors may contribute to insomnia in diabetics, including peripheral neuropathy-related discomfort or pain, restless legs syndrome, periodic limb movements, and rapid changes in blood glucose levels during the night, resulting in hypoglycemic and hyperglycemic episodes, nocturia, and associated depression(6)Diabetes patients have a considerably higher chance of developing depression than their nondiabetic counterparts, and depression is one of the major causes contributing to poor sleep in this population. Furthermore, diabetes has numerous effects on the central nervous system, including changes in neurobehavioral and neurotransmitter functioning, as well as autonomic activities, and can negatively affect endocrine functions, causing sleep problems. (7)

Aim: this review aims to address the aspects of insufficient sleep, diabetes mellitus, and their mutual interactions and interlinkages. The main objectives is to address the role and effect of diabetes on sleep.

METHODS AND MATERIALS

Type of the study: Systematic review

SAMPLE & STUDY GROUPS

PubMed and EBSCO Information Services were chosen as the search databases for the publications used within the study, as they are high-quality sources. PubMed being one of the largest digital libraries on the internet developed by the National Center for Biotechnology Information (NCBI) which is a part of the United States National Library of Medicine. Topics concerningthe aspects of insufficient sleep, diabetes mellitus, and their mutual interactions and interlinkages. The main objectives is to address the role and

effect of diabetes on sleep were used in the making of the article. The founded articles were screened by titles, and reviewing the abstracts.

Inclusion criteria: the articles were selected based on the relevance to the project which should include one of the following topics; 'Diabetes mellitus, Sleep quality, Quality of life, Sleep disturbance, Nocturnal hypoglycemia'.

Exclusion criteria: all other articles which do not have one of these topics as their primary end, or repeated studies, and reviews studies were excluded.

STATISTICAL ANALYSIS

No software will be utilized to analyze the data. The data wasextracted based on specific form that contains (Title of the publication, author's name, objective, summary, results, and outcomes). Double revision of each member's outcomes wasapplied to ensure the validity and minimize the mistakes.

During articles selection, studies were doubled-reviewed, and their results to assure that we enroll the studies related to the objective of our study, and to avoid or minimize errors in the results.

Results:

DM is one of the most common diseases worldwide. DM, in addition to causing direct sleep disturbances as a result of nocturia, polyuria, diabetic neuropathy and neuropathy pain, has also been associated with several chronic illness as obstructive sleep apnea, cardiovascular complications, hypertension, cerebrovascular accidents and depression which can impair sleep and quality of life. The patient may not bring the sleep issues during their visit to healthcare providers, with acute issues taking precedence during their visit.

Table 1: Relationship between diabetes and sleep disturbances (daytime sleep)

Author and publishing year	**Study area**	**methodology**	**outcome**
Safa Barakat et al, 2019 (8)	Amman, Jordan	A cross-sectional study was carried out at the National Center for Diabetes, Endocrinology and Genetics (NCDEG) in Amman, Jordan.A total of 1,211 (540 male and 671 female) patients with T2DM were recruited. Data were collected using the Pittsburgh sleep quality index (PSQI)	Poor sleep quality was reported in 81% of participants. Multivariate logistic regression analysis revealed that poor sleep quality was significantly associated

		to assess the sleep quality with a cutoff point of PSQI ≥ 8. Participants' demographic background data were also recorded. Statistical analysis was conducted using SPSS version 22.	with high HbA1c
Abdulaziz Darraj et al,2018 (9)	Jazan, Saudi Arabia.	In 2018, an analytical cross-sectional study of 307 diabetes patients was undertaken in Jazan, Saudi Arabia. The study participants were chosen using a multistage cluster random selection method. The Pittsburgh Sleep Quality Index was used to assess sleep quality (PSQI). Data on patient characteristics were gathered through patient interviews, while medical data was gathered from patients' files. The determinants of poor sleep quality were identified using logistic regression analysis.	Poor sleep quality among diabetic patients is a prevalent health problem. The prevalence of poor sleep quality was 55.4% (95% CI 49.7-60.8).
Seyed Morteza Shamshirgaran et al,2017	Iran	a cross-sectional study of diabetic patients sent to the Ardabil diabetes clinic in the northwest of Iran The Pittsburg Sleep Quality Index was used to collect information on sleep quality (PSQI). Data on sociodemographic lifestyle characteristics and psychological discomfort were gathered using a questionnaire.	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.
Samantha B. J. Schipper et al,2021 (11)	Multinational	A literature search was performed in PubMed from inception until January 2021, using MeSH and tiab search terms indicating sleep disorders and type 2 diabetes mellitus.	Sleep disorders are highly prevalent in people with type 2 diabetes, negatively affecting health outcomes.
Amarabalan Rajendran et al,2012 (12)	India	The study included 120 type 2 diabetes patients who attended an endocrinology clinic at a tertiary-care hospital. The Pittsburgh Sleep Quality Index was used to assess the sleep quality of all patients (PSQI). A Global Sleep Quality score of 5 can tell the difference between good and bad sleepers.	Patients with type 2 diabetes have a significant prevalence of sleep disruption. The mean global PSQI score in this population was 7.08 (standard deviation, 3.89), indicating poor sleep

			quality. Sixty-nine percent of patients received a global PSQI score of 5, suggesting that they slept poorly. The global PSQI score was favourably connected to the duration of diabetes and was also unaffected by age, gender, body mass index, HbA1c, or medicines.
Tadeg Jemere et al,2019 (13)	Ethiopia	From April 5 to May 5, 2018, Jimma University Medical Center (JUMC) conducted an institution-based comparative cross-sectional study. During the time of data collection, the Hospital served a total of 2594 persons with type 2 diabetes. The source groups were all adult Type 2 DM patients enrolled at JUMC and healthy persons who came to the hospital for regular reasons.	The prevalence of poor sleep quality was 55.6% among people with type 2 diabetes mellitus and 32.3% among controls.
Qi-Hui Jin et al,2012 (14)	china	The study comprised 130 hospitalised older people with type 2 diabetes. Within one week of admission, questionnaires and other clinical data were obtained. According to the Pittsburgh Sleep Quality Index, patients were split into two groups: poor sleepers and good sleepers (PSQI).	The elderly with type 2 diabetes are notoriously bad sleepers. Sixty percent slept poorly.
Anitra D M Koopman et al,2019 (15)	Multinational	Investigators A.D.M.K. and F.R. conducted a systematic search of the literature in MEDLINE (PubMed) and Embase till March 2018 with the assistance of a librarian. Additional papers were found by manually searching the reference lists of the included research. In short, the search technique was based on a combination of the following phrases and synonyms: (Type 2 diabetes OR NIIDM OR T2DM OR diabetes) AND (Insomnia OR sleep quality OR disturbed sleep).	In the T2D population, the prevalence of sleeplessness (symptoms) is 39%, and it may be connected with poor glycemic management.

Discussion:

Clinical studies have revealed that up to one-third of diabetic patients had concomitant sleep problems, compared to 8.2% of non-diabetic controls (16). According to a research poll done at the University of Pittsburgh, more than half of type 2 DM patients are likely to report being "bad sleepers." Patients with type 2 diabetes had a higher risk of having a low Pittsburgh Sleep Quality Index (PSQI) (17). (The PSQI is a validated tool for assessing sleep quality and pattern in older persons.) It distinguishes poor sleepers from normal sleepers by examining seven aspects of sleep over a one-month period)(17). Common insomnia characteristics, such as sleep latency and efficiency, are included as measurements in these indexes. The same study discovered that sleep quality was highly linked with other diabetic quality of life measures (18). Patients with other chronic medical disorders are more likely to develop sleeplessness in general.

Poor sleep and insomnia have been linked to a drop in gamma-aminobutyric acid levels in studies (GABA). Patients with depression had reduced GABA levels as well (19). GABA is produced in substantial quantities in the pancreas. It has also been demonstrated to prevent apoptosis in rodent beta cells. The principal enzyme (GAD) involved in the manufacture of GABA, glutamate decarboxylase, has been associated to type 1 diabetes (20). When GABA levels are low, it is possible that GABA is one of the neurotransmitters implicated in sleep quality in diabetics.

A Taiwanese study discovered that a lack of sleep was linked to a higher prevalence of diabetes (21). Another study conducted in Taiwan discovered that both short and long sleep durations were independently linked with newly diagnosed diabetes (22). A meta-analysis of the dose-response connection between sleep length and the risk of type 2 diabetes showed that those who obtain 7-8 hours of sleep per day have the lowest risk of T2DM, whereas short and long sleep duration are associated with a higher risk of T2DM (23).

Subjective sleep disruptions have been recorded in more than one-third of type 2 diabetes patients, which may be due to anxiety about poor blood glucose control and diabetic consequences (24). Previous research, however, found an inconsistent connection between perceived sleep disruptions and blood glucose levels. Some studies have found an inverse relationship between subjective sleep disruptions and poor glycemic management in type 2 diabetes patients (25), while others have found no relationship between subjective sleep disturbances and serum haemoglobin A1c (HbA1c) level as an indicator of glucose status(26). Nevertheless, studies that found a link between HbA1c

level and poor sleep quality did not properly eliminate or control for major risk factors associated with poor sleep quality (27). Shankar et al. discovered that perceived insufficient rest/sleep is independently linked with CVDs, diabetes mellitus, and obesity in a study on perceived insufficient rest included in the Behavioral Risk Factor Surveillance System (BRFSS) of the United States(28).

Conclusion and recommendations: DM causes night sleep disturbances which eventually leads to daytime sleeping. It is important for the health care providers treating the patient with DM to address their sleep issues and the impaired quality of life due to inadequate and fragmented sleep, as it may be severely affect their recovery, control of diabetes as well as quality of life. Sleep education should also be considered an essential part in the diabetic management armamentarium.

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