



**Daffodil**  
*International*  
**University**

**ASSESSMENT OF THE SLEEP QUALITY AMONG TYPE 2 DIABETES  
MELLITUS PATIENTS**

**A PROJECT REPORT**

**BY**

**ARPITA CHOWDHURY**

**ID: 193-34-1001**

Submitted to the Department of Nutrition and Food Engineering in the partial fulfillment of  
B.Sc. in Nutrition and Food Engineering

Supervised By

**Md. Harun-Ar Rashid**

**Assistant Professor**

Department of Nutrition and Food Engineering

**FACULTY OF HEALTH AND LIFE SCIENCES**

**DAFFODIL INTERNATIONAL UNIVERSITY**

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## **APPROVAL**

The project titled "**Assessment of the sleep quality among type 2 diabetes mellitus patients**" by **Arpita Chowdhury** has been accepted by the Department of Nutrition and Food Engineering at Daffodil International University. This acceptance is in partial fulfillment of the requirements for the B.Sc. degree in Nutrition and Food Engineering. Furthermore, the project has been approved for its style and content.

## **EXAMINING COMMITTEE**

Chairman of the Board \_\_\_\_\_

External Member \_\_\_\_\_

Internal Member-1 \_\_\_\_\_

Internal Member-2 \_\_\_\_\_

\_\_\_\_\_  
Dr. Nizam Uddin

Head

Department of Nutrition and Food Engineering

Faculty of Health and Life Sciences

Daffodil International University

## DECLARATION

I hereby declare that this project has been done by me under the **Md. Harun-Ar Rashid, Assistant Professor**, Department of Nutrition and Food Engineering, Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by:



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**Md. Harun-Ar Rashid**

**Assistant Professor**

Department of Nutrition and Food Engineering

Faculty of Health and Life Sciences

Daffodil International University

Submitted by:



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**ARPITA CHOWDHURY**

**ID: 193-34-1001**

Department of Nutrition and Food Engineering

Daffodil International University

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## ABSTRACT

This cross-sectional study aimed to assess the sleep quality among Type 2 Diabetes Mellitus (T2DM) patients attending BIRDEM General Hospital in Dhaka, Bangladesh, during the period from 19th August 2023 to 20th September 2023. A sample size of 150 participants was determined and were selected from the diagnosed T2DM patient population. Data collection tools included a structured questionnaire for demographic and clinical information, along with the Pittsburgh Sleep Quality Index (PSQI) questionnaire. Sleep quality was categorized as good (score  $\leq 6$ ) or poor (score  $> 6$ ). Sleep quality among the 150 patients with Type 2 Diabetes Mellitus (T2DM) reveals that a significant majority, 68.7%, were categorized as poor, while 31.3% were good. Sleep disturbance characteristics demonstrated a range of sleep-related issues, including subjective sleep quality, sleep latency, duration, disturbances, and the use of sleeping medication. Factors associated with poor sleep quality were analyzed, revealing a statistically significant association with BMI ( $p=0.035$ ), while other factors such as gender, age, residence, occupation, duration of T2DM, glycemic control, and treatment modalities did not show any significant associations. The significant association between BMI categories and sleep quality underscores the importance of addressing weight management as part of comprehensive diabetes care.

**Keywords:** Sleep, Quality, Assessment, T2DM, PSQI.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Sleep is an essential physiological function that is vital for the preservation of life (Iyer et al., 2012). This condition, as defined by Guyton (2006), refers to a state of unconsciousness from which a person may be awakened by sensory or other stimuli. During this phase, the body produces a significant number of crucial hormones that impact the processes of growth, sleep, energy control, metabolism, and endocrine function (Waterhouse et al., 2012). In order to keep our bodies healthy, it is crucial to have an adequate quantity of restorative sleep that meets our physiological requirements in terms of duration, timing, and regularity, while also ensuring the absence of any sleep disorders (Consensus et al., 2015). Individuals with diabetes mellitus are more susceptible to experiencing signs of sleep disturbance compared to the general population. These symptoms may be associated with diabetes itself or with the complications that occur as the disease progresses (Surani et al., 2015). Diabetes mellitus (DM), a metabolic condition, has been associated with disrupted sleep patterns (Shamshirgaran et al., 2017).

In recent decades, there has been a substantial increase in the prevalence of sleep disturbances and deprivation worldwide (Jemere et al., 2019). This tendency has coincided with the worldwide increase in the occurrence of diabetes and obesity. Multiple studies indicate that the prevalence of sleep disruptions in individuals with type 2 diabetes mellitus ranges from 38 to 97%. This leads to an augmented burden on carers and a reduction in the patients' Quality of life (Chasens et al., 2016).

Insufficient sleep has been associated with a diverse range of harmful health consequences, as well as an elevated risk of mortality. According to Economics (2017), it adversely affects cognitive function and significantly reduces workplace productivity due to absenteeism. Several studies have shown that individuals with type 2 diabetes are more likely to have suboptimal sleep quality. The characteristics that contribute to this include being of the female gender, having a low income, experiencing a longer duration of the disease, having inadequate control over blood sugar levels, and having hypertension (Kodakandla et al., 2016).

### 1.2 Background

Globally, there is an escalating prevalence of diabetes mellitus (DM) attributed to variables such as advancing age, urbanization, obesity, and lack of physical exercise (Shiberu et al., 2018). The global prevalence of diabetes was predicted to be 9.3% in 2019, affecting around 463 million people. This number is projected to increase to 10.2% (578 million persons) by 2030 and 10.9% (700 million individuals) by 2045, according to Darraj et al. (2018). According to Lecube et al. (2016), about 47.6% of individuals with diabetes had poor sleep quality on a global scale.

The decreased sleep quality experienced by individuals with diabetes mellitus (DM) may be attributed to reduced saturation levels, pain, restless leg syndrome, nocturnal polyuria,

and nocturnal hypoglycemia (Surani et al., 2015). Inadequate sleep may lead to cognitive impairment and reduced cognitive performance in patients with diabetes mellitus. Rajendran et al. (2012) found that there is a correlation between poor sleep quality in individuals with diabetes mellitus (DM) and many characteristics including age, gender, body mass index, loud settings, smoking, and drinking behaviors. In people with diabetes mellitus, experiencing inadequate sleep may result in non-compliance with prescribed medication, insulin resistance, cardiovascular disease, cognitive impairment, and reduced job performance. Additionally, it hampers cognitive function and may result in an increased susceptibility to stroke and depression (Adams et al., 2017).

### **1.3 Study objectives**

The main objective of this study was to assess the sleep quality among Type 2 Diabetes Mellitus (T2DM) patients.

#### **1.3.1 Specific objectives**

- To investigate the socio-demographic characteristics of patients with T2DM.
- To evaluate clinical characteristics of patients with T2DM.
- To investigate sleep pattern among patients with T2DM using Pittsburgh Sleep Quality Index (PSQI).
- To find out factors associated with sleep quality among patients.

## CHAPTER 2

### LITERATURE REVIEW

Patients diagnosed with type 2 diabetes mellitus (T2DM) often have substandard sleep patterns (Saparwan et al., 2023). It has adverse impacts on both physical and psychological well-being, as well as on overall quality of life. The objective of this research was to ascertain the frequency of inadequate sleep quality among individuals with type 2 diabetes mellitus (T2DM) and to examine the variables linked to this condition. Saparwan et al. (2023) gathered data by using the Malay adaptation of the Pittsburgh Sleep Quality Index (PSQI-M), where a cut-off point of  $>6$  was used to indicate poor sleep quality. There were 319 individuals with T2DM who took part in the study. The average age of the participants was 63 years with a standard deviation of 11 years. Among the participants, 58% were women and 42.9% identified themselves as of Indian ancestry. The average total score of the Pittsburgh Sleep Quality Index (PSQI) was 4.04 with a standard deviation of 2.21. Additionally, 23% of the individuals were found to have poor sleep quality. Approximately 25% of the T2DM patients examined had a high prevalence of poor sleep quality. Indian individuals of a certain ethnic background, who are either separated or widowed, have frequent urination at night and exhibit signs of depression, which are all independently linked to a worse quality of sleep. Although the occurrence of poor sleep quality is less common in this study compared to previous research, it is important to investigate further in order to identify those who are at a greater risk. This will help in managing the lifestyle of patients with type 2 diabetes mellitus (T2DM) more effectively (Saparwan et al., 2023).

There is a suspicion that sleep disruption is more likely to occur during the COVID-19 pandemic, and those with type 2 diabetes mellitus are recognized to be at a greater risk of experiencing sleep disruption (Abdu et al., 2023). Abdu et al. (2023) investigated the frequency and factors influencing sleep disruption during the COVID-19 pandemic using the Pittsburgh Sleep Quality Index (PSQI). The average age ( $\pm$  standard deviation) was 51.4 ( $\pm$  9.5) years, and 64.3% of the participants in the research were male. The median duration of diabetes, shown by the interquartile range (IQR), was 10 years with a standard deviation of 11 years. In addition, 6.3% of the participants were using insulin. The HbA1c median value was 7.6% with a standard deviation of 2.4. Thirty percent of the patients ( $n=103$ ; 35.8%) experienced poor sleep quality, as indicated by a PSQI score greater than 5. There was a significant statistical correlation between poor sleep quality and many factors, including being young, having a history of sleep disruption, being diagnosed with sleep disorders in the past, having a high depression score, and having a high perceived stress score. After accounting for confounding factors, only a high score on the depressed symptoms scale and a past history of sleep problem were revealed to be significant predictors of poor sleep quality ( $p < 0.001$ ). The adjusted odds ratios were 1.421 (95% CI: 1.242–1.625) and 3.208 (95% CI: 1.574–6.537) for depressive symptoms and sleep disorder history, respectively. The incidence of substandard sleep quality among individuals with Type 2 Diabetes Mellitus (T2DM) during the COVID-19 pandemic was substantial (Abdu et al., 2023).

Sleep quality disturbance serves as both a predisposing factor for individuals with diabetes and a manifestation of sadness. In 2022, Sokoty et al. conducted a study in

Delijan city to establish the correlation between sleep quality and depression in individuals diagnosed with type 2 diabetes. The average (standard deviation) age of the participants was 57.58 (10.58) years. Out of the total number of participants, 162 individuals, accounting for 66.1% of the sample, identified as female. A strong correlation was found between the sleep quality of individuals with type 2 diabetes and factors such as gender, education, family history of type 2 diabetes, age, as well as between depression and gender and fasting blood glucose levels. An empirically significant correlation was found between the quality of sleep and the presence of depression. Furthermore, the logistic regression analysis revealed a significant association between sleep quality (dependent variable) and depression, age, sex, and education (Sokoty et al., 2023). The findings indicate a notable correlation between sleep quality and depression in individuals with T2DM. Therefore, it is advisable to include this information into regular treatment for diabetic individuals to assess for depression, perhaps leading to an enhancement in their sleep quality.

Inadequate sleep quality is an underreported and underrecognized issue that may impact the prognosis of individuals with diabetes. In a tertiary care hospital in Dhaka, Khan et al. (2023) examined the frequency of inadequate sleep quality and the variables linked to it among patients with diabetes mellitus. The total incidence of inadequate sleep quality was 81.85%. The multivariable analysis revealed that being married (AOR: 6.10, 95% CI: 1.03-35.93,  $p=0.04$ ), consuming alcohol (AOR: 12.11, 95% CI: 1.39-65.53,  $p=0.02$ ), lack of physical exercise (AOR: 11.99, 95% CI: 1.26-78.93,  $p=0.03$ ), high HbA1c levels (AOR: 3.48, 95% CI: 1.21-21.71,  $p=0.01$ ), and low HDL cholesterol (AOR: 18.60, 95% CI: 6.73-94.56,  $p=0.04$ ) were significantly associated with poor sleep quality. A majority of over 80% of patients had poor sleep quality. Alcohol use, smoking, type 2 diabetes mellitus, and inadequate glycemic management were identified as contributing variables to impaired sleep quality (Khan et al., 2023).

Abnormal amounts of sleep, either too much or too little, disturbs the regulation of blood sugar levels in individuals diagnosed with type 2 diabetes mellitus (T2DM). Nevertheless, the data regarding the connection between the amount and quality of sleep and the regulation of blood sugar levels in Asian individuals with diabetes is still uncertain. Azharuddin et al. (2020) conducted a comprehensive study of existing research and combined the results to investigate the impact of sleep duration and sleep quality on the regulation of blood sugar levels in Asian individuals with type 2 diabetes mellitus (T2DM). In all, the meta-analysis included a total of seven investigations. The data showed brief sleep was linked with substantially increased HbA1c levels compared to regular sleep (MD: 0.11; 95% CI: 0.06–0.17). Extended periods of sleep were shown to be correlated with notably elevated levels of fasting plasma glucose (FPG) (mean difference: 5.30; 95% confidence interval: 3.27–7.34) in comparison to regular sleep durations. The study conducted by Azharuddin et al. (2020) found that there was a substantial decrease in fasting plasma glucose (FPG) levels (mean difference: 11.28; 95% confidence interval: 5.13–17.42) in those with good sleep quality compared to those with poor sleep quality. The research proposed that both the length and quality of sleep are believed to have a significant role in the metabolic function of individuals with type 2 diabetes.

## CHAPTER 3

### MATERIALS AND METHODS

#### 3.1 Study design and period

This study utilized a cross-sectional design to assess the sleep quality among Type 2 Diabetes Mellitus (T2DM) patients. The data collection period was from 19<sup>th</sup> August 2023 to 20<sup>th</sup> September 2023.

#### 3.2 Study area

The study will be conducted in BIRDEM General Hospital in 122 Kazi Nazrul Islam Ave, Dhaka-1000, Bangladesh.

#### 3.3 Sample size determination and sampling procedure

The sample size was determined of 150 patients with Type 2 DM according to the previous study of Al-Humairi et al., (2018). The sample size was determined using the Raosoft online calculator, a specialized tool for population surveys that calculates the required sample size and the number of responds needed with 7.98% margin of error, 95% confidence interval and population proportion 0.50.

$$\begin{aligned} \text{Sample size, } n &= \frac{z^2 \times \hat{p}(1 - \hat{p})}{\varepsilon} & \text{Where,} \\ &= \frac{(1.96)^2 \times 0.5(1 - 0.5)}{(0.08)^2} & z \text{ is the } z \text{ score} \\ &= \frac{3.8416 \times 0.25}{0.0064} & \varepsilon \text{ is the margin of error} \\ &= \frac{0.9604}{0.0064} & \hat{p} \text{ is the population proportion} \\ &= 150 \end{aligned}$$

#### 3.4 Source and study population

The source population includes all diagnosed Type 2 Diabetes Mellitus patients attending BIRDEM General Hospital during the study period. The study population consists of T2DM patients who meet the inclusion criteria.

##### 3.4.1 Inclusion criteria

Patients who are 18 years of age or older, clinically diagnosed with Type 2 Diabetes Mellitus, desiring to engage and provide informed consent were included in this study.

##### 3.4.2 Exclusion criteria

Patients with other forms of diabetes (e.g., Type 1 Diabetes Mellitus), patients exhibiting profound cognitive impairment, individuals who have diagnosed sleep issues that are not connected to diabetes and unwillingness to engage were excluded from this study.

#### 3.5 Data collection tools and procedures

Demographic information (age, gender, etc.) and relevant clinical parameters (glycemic control, duration of diabetes, etc.) were collected using a structured questionnaire

(Appendix 1), interview and medical record review. Additionally, the primary data collection tool was the Pittsburgh Sleep Quality Index (PSQI) questionnaire (Appendix 2).

### 3.6 PSQI scoring

The Pittsburgh Sleep Quality Index (PSQI) has 19 questions that individuals assess themselves. Scoring only includes questions that are assessed by the individuals themselves. The 19 elements that individuals evaluate themselves on are aggregated to create seven "component" ratings, each of which falls within a range of 0 to 3 points. A number of "0" denotes absence of difficulty, while a score of "3" signifies significant difficulty in all instances. The seven individual component scores are summed to provide a single "global" score, ranging from 0 to 21 points. A score of 0 indicates no difficulty, while a score of 21 indicates considerable problems in all categories.

**Table 1: PSQI scoring for Overall Sleep Quality**

| Sleep quality | PSQI Global Scoring           | Reference               |
|---------------|-------------------------------|-------------------------|
| Good          | Score less than or equal to 6 | (Saparwan et al., 2023) |
| Poor          | Score greater than 6          |                         |

### 3.7 Data processing and analysis

Collected data was entered into Microsoft Excel 2021 manufactured by Microsoft Corporation. SPSS (Statistical Package for the Social Sciences) version 25 developed by IBM was used for data analysis, which involved descriptive statistics for demographic and clinical variables. The sleep quality was determined based on PSQI scores. Inferential statistics, such as chi-square test was used to discover associations between sleep quality and relevant variables.

### 3.8 Ethical consideration

Participants were provided with detailed information about the study objectives, procedures, potential risks, and benefits. Informed consent was obtained from each participant before enrollment.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### 4.1 Results

The table 2 represents the socio-demographic characteristics of 150 patients with Type 2 Diabetes Mellitus (T2DM). T2DM affects individuals across various socio-demographic groups. The prevalence among different age groups, marital statuses, religions, education levels, and occupations underscores the complexity of the disease and highlights the need for diverse approaches to manage and address T2DM in the community. The gender distribution among T2DM patients in the sample is relatively balanced, with 51.3% female and 48.7% male. The majority of patients fall into the 50-59 years age group 36.0%, followed by the 40-49 years age group 22.7%. A significant proportion of the patients are married 94.7%. The majority of patients in the sample are Muslim 78.0%, with Hindus comprising the remaining 22.0%. The educational distribution reveals a diverse range, with a majority of patients having completed college and above 55.3%. Housewives make up a significant portion of the sample 40.7%.

**Table 2: Socio-Demographic Characteristics of Patients with T2DM**

| Characteristics       | Variables             | n=150 | %    |
|-----------------------|-----------------------|-------|------|
| <b>Gender</b>         | Female                | 77    | 51.3 |
|                       | Male                  | 73    | 48.7 |
| <b>Age group</b>      | 20-29 years           | 2     | 1.3  |
|                       | 30-39 years           | 20    | 13.3 |
|                       | 40-49 years           | 34    | 22.7 |
|                       | 50-59 years           | 54    | 36.0 |
|                       | 60-69 years           | 31    | 20.7 |
|                       | 70+ years             | 9     | 6.0  |
| <b>Marital Status</b> | Married               | 142   | 94.7 |
|                       | Single                | 3     | 2.0  |
|                       | Widowed               | 5     | 3.3  |
| <b>Religion</b>       | Muslim                | 117   | 78.0 |
|                       | Hindu                 | 33    | 22.0 |
| <b>Education</b>      | Cannot read and write | 1     | .7   |
|                       | Read and write        | 8     | 5.3  |
|                       | Primary school        | 12    | 8.0  |
|                       | Secondary school      | 46    | 30.7 |
|                       | College and above     | 83    | 55.3 |
| <b>Residence</b>      | Rural                 | 74    | 49.3 |
|                       | Urban                 | 76    | 50.7 |
| <b>Occupation</b>     | Farmer                | 10    | 6.7  |
|                       | Government employee   | 26    | 17.3 |
|                       | Housewife             | 61    | 40.7 |
|                       | Others                | 24    | 16.0 |

|  |              |    |      |
|--|--------------|----|------|
|  | Private work | 29 | 19.3 |
|--|--------------|----|------|

Table 3 provides insights into the clinical characteristics of patients with Type 2 Diabetes Mellitus (T2DM). The clinical characteristics of patients with T2DM in this sample reflect a varied and diverse profile. The distribution of disease duration, glycemic control, treatment modalities, and BMI categories underscores the heterogeneous nature of T2DM. The majority of patients seem to have relatively good glycemic control, and the distribution across BMI categories highlights the importance of considering individualized approaches to diabetes management based on clinical and demographic characteristics. The majority of patients in the sample have been living with T2DM for 1–4 years 50.0%, and a similar percentage falls into the 5–10 years category 49.3%. Only a very small percentage has had T2DM for more than 10 years 0.7%. A significant proportion of patients (80.7%) in the study have good glycemic control. However, it's important to address the 19.3% with poor glycemic control to improve their diabetes management. A notable percentage of patients are on oral medication 46.0%, while a slightly lower percentage is on insulin therapy 36.7%. Additionally, 17.3% of patients are using a combination of both insulin and oral medications. The BMI distribution reveals that a significant portion of patients falls into the normal weight category 44.7%. However, there are substantial percentages of patients who are overweight 38.7% and obese 9.3%. The presence of underweight individuals 6.7% is relatively low. There are a small percentage of patients classified as extremely obese 0.7%.

**Table 3: The Clinical Characteristics of Patients with T2DM**

| Characteristics             | Variables       | n=150 | %    |
|-----------------------------|-----------------|-------|------|
| <b>Duration of T2DM</b>     | 1–4 years       | 75    | 50.0 |
|                             | 5–10 years      | 74    | 49.3 |
|                             | >10 years       | 1     | .7   |
| <b>Glycemic Control</b>     | Good            | 121   | 80.7 |
|                             | Poor            | 29    | 19.3 |
| <b>Treatment Modalities</b> | Insulin         | 55    | 36.7 |
|                             | Oral            | 69    | 46.0 |
|                             | Both            | 26    | 17.3 |
| <b>BMI</b>                  | Underweight     | 10    | 6.7  |
|                             | Normal          | 67    | 44.7 |
|                             | Overweight      | 58    | 38.7 |
|                             | Obese           | 14    | 9.3  |
|                             | Extremely Obese | 1     | .7   |

Table 4 presents characteristics related to sleep disturbance among patients with Type 2 Diabetes Mellitus (T2DM). The data highlights a range of sleep-related issues among patients with T2DM, including variations in subjective sleep quality; sleep latency, duration, and disturbances. The prevalence of poor sleep quality and the use of sleeping medication underscore the importance of addressing sleep-related concerns as part of the overall management of individuals with T2DM. Majorities of patient's report either fairly good 41.3% or very good 20.0% subjective sleep quality. However, a significant portion

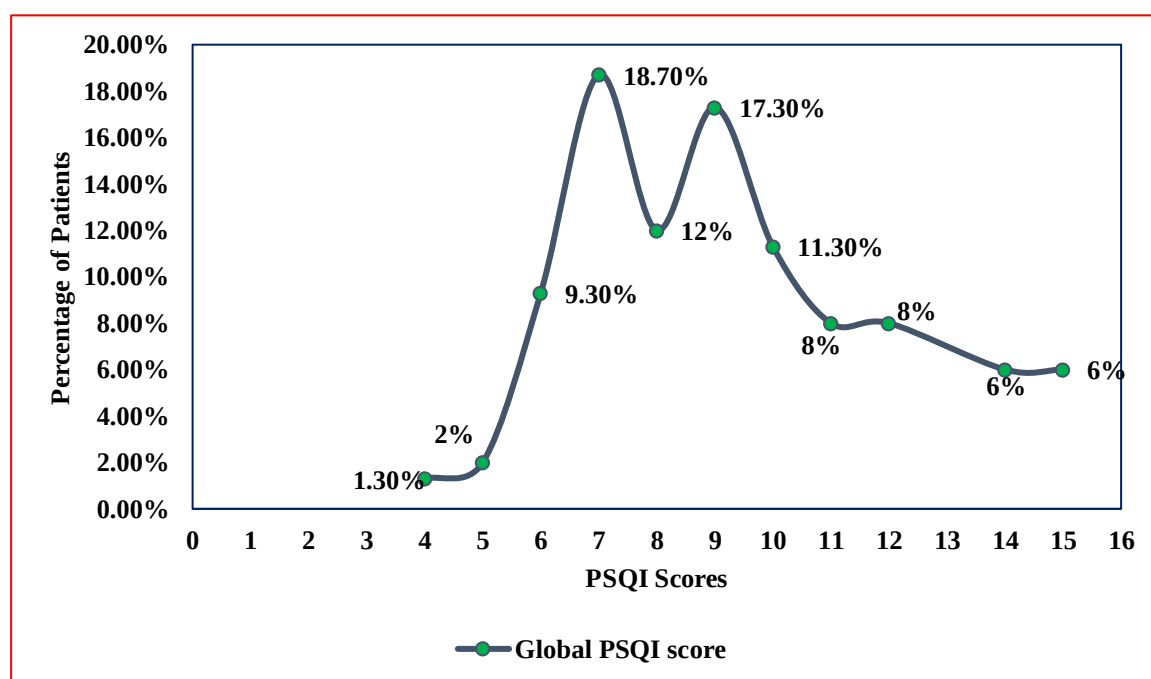
also reports fairly bad 26.0% or very bad 12.7% sleep quality. Sleep latency, or the time it takes to fall asleep, is distributed across different categories. A considerable percentage of patients experience a sleep latency of 16-30 minutes 48.0%. It's noteworthy that 18.7% report sleep latency of 15 minutes or less, while 12.0% take more than 60 minutes to fall asleep. The distribution of sleep duration shows that a significant proportion of patients (46.0%) sleep for 6-7 hours, while a smaller percentage (6.0%) sleep more than 7 hours. Notably, a substantial number of patients (33.3%) report sleeping for 5-6 hours. Habitual sleep efficiency, which measures the percentage of time spent asleep while in bed, varies among patients. A substantial number report a sleep efficiency of 75-84% (32.7%) and 65-74% (43.3%). A majority of patients report experiencing sleep disturbances at least once a week. This includes 49.3% reporting 1 time a week, 30.7% reporting 1–2 times a week, and 12.0% reporting sleep disturbances  $\geq 3$  times a week. The use of sleeping medication is reported at different frequencies. A significant number of patients (35.3%) have not used sleeping medication in the past month, while others report using it less than once a week (36.0%) or once or twice a week (28.7%). Daytime dysfunction is reported by a substantial number of patients, with 43.3% reporting 1-2 times a week, and 18.0% reporting 3-4 times a week. A smaller percentage (12.0%) report experiencing daytime dysfunction 5-6 times a week. Overall assessment of sleep quality, categorizing patients as either good sleepers (31.3%) or poor sleepers (68.7%).

**Table 4: Characteristics of Sleep Disturbance Among Patients with T2DM**

| Characteristics           | Variables                 | n=150 | %    |
|---------------------------|---------------------------|-------|------|
| Subjective sleep quality  | Very good                 | 30    | 20.0 |
|                           | Fairly good               | 62    | 41.3 |
|                           | Fairly bad                | 39    | 26.0 |
|                           | Very bad                  | 19    | 12.7 |
| Sleep latency             | $\leq 15$ minutes         | 28    | 18.7 |
|                           | 16-30 minutes             | 72    | 48.0 |
|                           | 31-60 minutes             | 32    | 21.3 |
|                           | $> 60$ minutes            | 18    | 12.0 |
| Sleep duration            | $> 7$ hours               | 9     | 6.0  |
|                           | 6-7 hours                 | 69    | 46.0 |
|                           | 5-6 hours                 | 50    | 33.3 |
|                           | $< 5$ hours               | 22    | 14.7 |
| Habitual sleep efficiency | $> 85\%$                  | 18    | 12.0 |
|                           | 75-84%                    | 49    | 32.7 |
|                           | 65-74%                    | 65    | 43.3 |
|                           | $< 65\%$                  | 18    | 12.0 |
| Sleep disturbances        | Never                     | 12    | 8.0  |
|                           | 1 time a week             | 74    | 49.3 |
|                           | 1–2 times a week          | 46    | 30.7 |
|                           | $\geq 3$ times a week     | 18    | 12.0 |
| Use of sleeping           | Not during the past month | 53    | 35.3 |

|                     |                       |     |      |
|---------------------|-----------------------|-----|------|
| medication          | Less than once a week | 54  | 36.0 |
|                     | Once or twice a week  | 43  | 28.7 |
| Daytime dysfunction | Never                 | 40  | 26.7 |
|                     | 1-2 times a week      | 65  | 43.3 |
|                     | 3-4 times a week      | 27  | 18.0 |
|                     | 5-6 times a week      | 18  | 12.0 |
| Sleep Quality       | Good Sleeper          | 47  | 31.3 |
|                     | Poor Sleeper          | 103 | 68.7 |

The graph chart (Figure 1) provides a detailed breakdown of the distribution of Global PSQI scores within the surveyed population. The distribution shows variability in sleep quality, with individuals reporting scores ranging from 4 to 15. The most frequent score is 7, with 28 occurrences (18.7%). Scores 9 and 6 also have substantial representation, with 26 (17.3%) and 14 (9.3%) occurrences, respectively. The distribution appears to be somewhat symmetric, with a peak around scores 7 and 9, and a gradual decline towards both lower and higher scores. Lower scores (4, 5, 6) indicate better sleep quality, while higher scores (14, 15) suggest poorer sleep quality.



**Figure 1: Global PSQI score of the T2DM patients**

Table 5 explores factors associated with poor sleep quality among patients with Type 2 Diabetes Mellitus (T2DM). The analysis suggests that BMI is the only factor in this study that has a statistically significant association with sleep quality among patients with T2DM. Other factors such as gender, age, residence, occupation, duration of T2DM, glycemic control, and treatment modalities do not show significant associations. There is no statistically significant association between gender and sleep quality ( $p = 0.692$ ). The association between age group and sleep quality is not statistically significant ( $p = 0.684$ ). The association between residence (rural or urban) and sleep quality is not statistically significant ( $p = 0.179$ ). The distribution of sleep quality among different occupations does

not show a significant association ( $p = 0.858$ ). The duration of T2DM is not significantly associated with sleep quality ( $p = 0.789$ ). The association between glycemic control and sleep quality is not statistically significant ( $p = 0.394$ ). The distribution of sleep quality among different treatment modalities (both insulin and oral, insulin only, oral only) is not significantly associated ( $p = 0.832$ ). There is a statistically significant association between BMI and sleep quality ( $p = 0.035$ ).

**Table 5: Factors Associated with Sleep Quality Among Patients with T2DM**

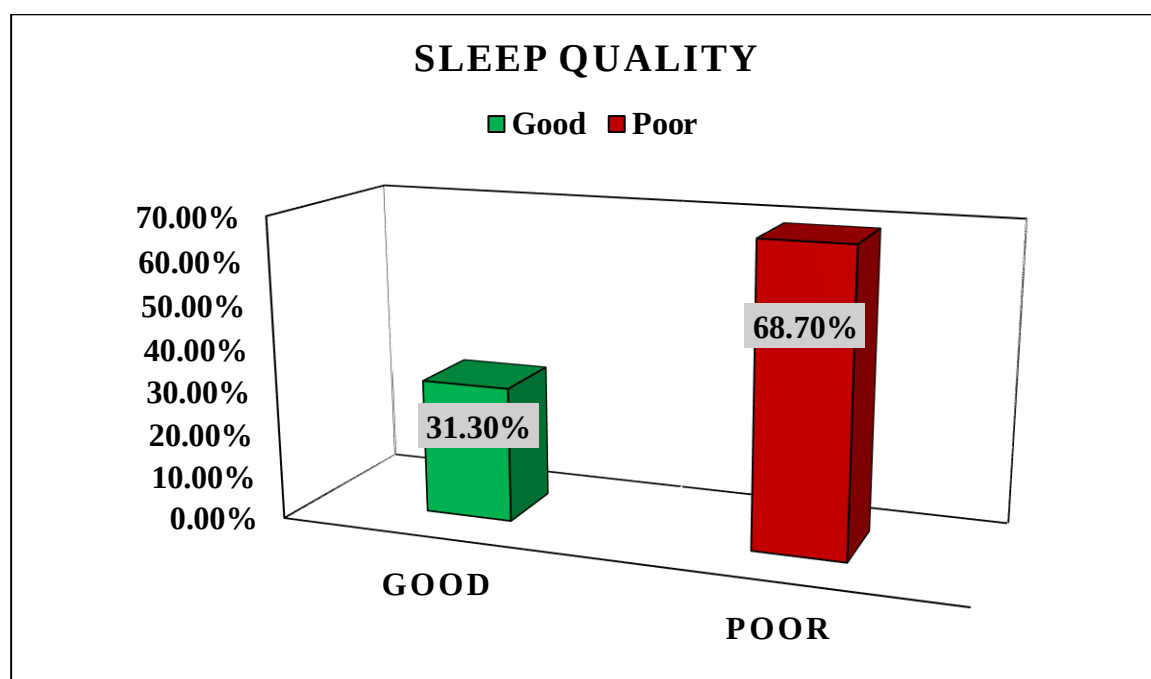
| Variables                   | Sleep Quality     |                            | p value |
|-----------------------------|-------------------|----------------------------|---------|
|                             | Good<br>47(31.3%) | Poor Sleeper<br>103(68.7%) |         |
| <b>Gender</b>               |                   |                            | 0.692   |
| Female                      | 23(15.3%)         | 54(36.0%)                  |         |
| Male                        | 24(16.0%)         | 49(32.7%)                  |         |
| <b>Age group</b>            |                   |                            | 0.684   |
| 20-29 years                 | 1(0.7%)           | 1(0.7%)                    |         |
| 30-39 years                 | 8(5.3%)           | 12(8.0%)                   |         |
| 40-49 years                 | 8(5.3%)           | 26(17.3%)                  |         |
| 50-59 years                 | 15(10.0%)         | 39(26.0%)                  |         |
| 60-69 years                 | 12(8.0%)          | 19(12.7%)                  |         |
| 70+ years                   | 3(2.0%)           | 6(4.0%)                    |         |
| <b>Residence</b>            |                   |                            | 0.179   |
| Rural                       | 27(18.0%)         | 47(31.3%)                  |         |
| Urban                       | 20(13.3%)         | 56(37.3%)                  |         |
| <b>Occupation</b>           |                   |                            | 0.858   |
| Farmer                      | 3(2.0%)           | 7(4.7%)                    |         |
| Government employee         | 10(6.7%)          | 16(10.7%)                  |         |
| Housewife                   | 20(13.3%)         | 41 (27.3%)                 |         |
| Others                      | 6(4.0%)           | 18(12.0%)                  |         |
| Private work                | 8(5.3%)           | 21(14.0%)                  |         |
| <b>Duration of T2DM</b>     |                   |                            | 0.789   |
| >10 years                   | --                | 1(0.7%)                    |         |
| 1–4 years                   | 24(16.0%)         | 51(34.0%)                  |         |
| 5–10 years                  | 23(15.3%)         | 51(34.0%)                  |         |
| <b>Glycemic Control</b>     |                   |                            | 0.394   |
| Good                        | 36(24.0%)         | 85(56.7%)                  |         |
| Poor                        | 11(7.3%)          | 18(12.0%)                  |         |
| <b>Treatment Modalities</b> |                   |                            | 0.832   |
| Both                        | 7(4.7%)           | 19(12.7%)                  |         |
| Insulin                     | 17(11.3%)         | 38(25.3%)                  |         |
| Oral                        | 23(15.3%)         | 46(30.7%)                  |         |
| <b>BMI</b>                  |                   |                            | 0.035*  |
| Underweight                 | 5(3.3%)           | 5(3.3%)                    |         |

|                 |           |           |  |
|-----------------|-----------|-----------|--|
| Normal          | 22(14.7%) | 45(30.0%) |  |
| Overweight      | 19(12.7%) | 39(26.0%) |  |
| Obese           | --        | 14(9.3%)  |  |
| Extremely Obese | 1(0.7%)   | --        |  |

*\*Indicates statistically significant ( $p < 0.05$ ).*

## 4.2 Discussion

Poor sleep quality poses a significant concern for individuals with diabetes mellitus (DM) as it heightens the likelihood of insulin resistance and DM-related complications. Improving sleep management can enhance the probability of improved diabetes management, and effective management of diabetes mellitus can enhance the quality of sleep (Chattu et al., 2019). The study revealed that 68.70% of individuals with DM experienced poor sleep quality. The results of this study were greater than those of previous studies conducted in Ethiopia (55.6%) (Berhanu et al., 2018), Kenya (53.4%) (Sokwalla et al., 2017), India (64%) (Khandelwal et al., 2017), Saudi Arabia (61.6%) (Darraj et al., 2018), and Turkey (64.3%) (Keskin et al., 2015). However, the general occurrence of inadequate sleep quality among individuals with diabetes mellitus (DM) was lower compared to the United States, where it was reported to be 80% (Chasens et al., 2014) and 84% (Chasens et al., 2016) in two separate studies. In Sudan, the prevalence was found to be 97.1% (Mirghani et al., 2015), while in Saudi Arabia it was 72% (Alshenghiti et al., 2016).



**Figure 1: Sleep Quality of the T2DM patients**

The current investigation did not see any indication of a correlation between age and the occurrence of sleep disturbances in individuals with diabetes. Previous research has indicated that the patient's age is a significant determinant in their sleep quality, as demonstrated by studies conducted by Alshenghiti et al. (2016), Yaggi et al. (2006), GH

et al. (2011), and Knutson et al. (2006). The variation likely occurred due to the diverse health and sickness profiles within the research population. Although the current study did not discover a statistically significant correlation between occupation and sleep quality, two earlier studies have noted a connection between occupation and sleep length, sleep efficacy, and the amount of sleep medicine taken (Yaggi et al., 2006; GH et al., 2011). Furthermore, it demonstrated a notable correlation just with Body mass index, while not exhibiting any connection with other demographic factors such as age, marital status, occupation, or domicile. Additional research has revealed a significant association between sleep issues and many demographic and lifestyle factors in individuals with diabetes, such as marital status, occupation, age, gender, and degree of physical activity. Prior research have examined many factors such as exercise frequency, insulin consumption, length of illness, age, and gender to determine if they can predict the occurrence of sleep disturbances (Yaggi et al., 2006; GH et al., 2011; Knutson et al., 2006). Nevertheless, the study was conducted using a cross-sectional design and had a rather small sample size. Furthermore, the results of this study may be linked to both information and selection bias.

## **CHAPTER 5**

### **CONCLUSION**

#### **5. Conclusion**

This study provides valuable understandings into the socio-demographic, clinical, and sleep-related characteristics of patients with T2DM. The characteristics of sleep disturbance among T2DM patients demonstrated varied subjective sleep quality, sleep latency, duration, and efficiency. A substantial number of patients reported sleep disturbances at least once a week, and a significant percentage experienced daytime dysfunction. The overall sleep quality categorized a majority as poor sleepers. A statistically significant association was also found between Body Mass Index (BMI) and sleep quality. The findings emphasize the importance of addressing sleep disturbances, particularly among those with poor glycemic control and higher BMI.

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## APPENDICES

### Appendix 1: Questionnaires

#### QUESTIONNAIRE

Date: \_\_\_\_/\_\_\_\_/2023

Serial no:

#### INFORMATION ABOUT PATIENT

- a) Name :
- b) Address :
- c) Name of the Hospital :
- d) Reason of admission :
- e) Word No :
- f) Bed No :

#### DEMOGRAPHIC INFORMATION

- 1. Sex: ☐Male ☐Female
- 2. Age group: \_\_\_\_\_years
- 3.Height:\_\_\_\_\_ft\_\_\_\_\_inch
- 4.Weight:\_\_\_\_\_kg
- 5. Marital status: ☐Single ☐Married ☐Divorced ☐Widowed
- 6. Religion: ☐Muslim ☐Hindu ☐Others
- 7. Education: ☐Cannot read and write ☐Read and write ☐Primary school ☐Secondary school ☐College and above
- 8. Residence: ☐Urban ☐Rural
- 9. Occupation: ☐Government employee ☐Farmer ☐Housewife ☐Merchant ☐Private work ☐Others
- 10. Living status: ☐Alone ☐With family

#### DIABETES AND COMORBIDITY

- 11. Duration of DM (in years): ☐1–4 years ☐5–10 years ☐>10 years
- 12. Type of DM: ☐Type 1 ☐Type 2
- 13. Glycemic control: ☐Good ☐Poor

**14. Treatment modalities:** ☐Oral ☐Insulin ☐Both

**15. BMI (Body Mass Index):** ☐Underweight ☐Normal ☐Overweight ☐Obese

## **MENTAL AND BEHAVIORAL HEALTH**

16. Depression: ☐Yes ☐No

17. Anxiety: ☐Yes ☐No

18. Smoking: ☐Never smoke ☐Currently smoking ☐Past smoker

19. Drinking alcohol: ☐Yes ☐No

## **PART TWO**

### **Pittsburgh Sleep Quality Index**

**The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month.**

1. During the past month, when have you usually gone to bed at night? Usual bed time \_\_\_\_\_

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night? Number of minutes \_\_\_\_\_

3. During the past month, when have you usually gotten up in the morning? Usual getting up time \_\_\_\_\_

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spend in bed.) Hours of sleep per night \_\_\_\_\_

**For each of the remaining questions, check the one best response. Please answer all questions**

| <b>5. During the past month, how often have you had trouble sleeping because you...</b> |                               |                           |                          |                                |
|-----------------------------------------------------------------------------------------|-------------------------------|---------------------------|--------------------------|--------------------------------|
|                                                                                         | Not during the past month (0) | Less than once a week (1) | Once or twice a week (2) | Three or more times a week (3) |
| a. cannot get to sleep                                                                  | <input type="checkbox"/>      | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>       |

|                                                        |                          |                          |                          |                          |
|--------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| within 30 minutes                                      |                          |                          |                          |                          |
| b. wake up in the middle of the night or early morning | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c. have to get up to use the bathroom                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d. cannot breathe comfortably                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e. cough or snore loudly                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f. feel too cold                                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| g. feel too hot                                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| h. have bad dreams                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| i. have pain                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

j. other reason(s), please describe \_\_\_\_\_

|                                                                                | Not during the past month (0) | Less than once a week (1) | Once or twice a week (2) | Three or more times a week (3) |
|--------------------------------------------------------------------------------|-------------------------------|---------------------------|--------------------------|--------------------------------|
| How often during the past month have you had trouble sleeping because of this? | <input type="checkbox"/>      | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>       |

|                                                                                                                                     | <b>Very good (0)</b>                 | <b>Fairly good (1)</b>                | <b>Fairly bad (2)</b>            | <b>Very bad (3)</b>                   |
|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|---------------------------------------|----------------------------------|---------------------------------------|
| 6. During the past month, how would you rate your sleep quality overall?                                                            | <input type="checkbox"/>             | <input type="checkbox"/>              | <input type="checkbox"/>         | <input type="checkbox"/>              |
|                                                                                                                                     | <b>Not during the past month (0)</b> | <b>Less than once a week (1)</b>      | <b>Once or twice a week (2)</b>  | <b>Three or more times a week (3)</b> |
| 7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?                   | <input type="checkbox"/>             | <input type="checkbox"/>              | <input type="checkbox"/>         | <input type="checkbox"/>              |
|                                                                                                                                     | <b>Not during the past month (0)</b> | <b>Less than once a week (1)</b>      | <b>Once or twice a week (2)</b>  | <b>Three or more times a week (3)</b> |
| 8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity? | <input type="checkbox"/>             | <input type="checkbox"/>              | <input type="checkbox"/>         | <input type="checkbox"/>              |
|                                                                                                                                     | <b>No problem at all (0)</b>         | <b>Only a very slight problem (1)</b> | <b>Somewhat of a problem (2)</b> | <b>A very big problem (3)</b>         |
| 9. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?                       | <input type="checkbox"/>             | <input type="checkbox"/>              | <input type="checkbox"/>         | <input type="checkbox"/>              |

|                                             | <b>No bed partner or room mate</b> | <b>Partner/room mate in other room</b> | <b>Partner in same room, but not same bed</b> | <b>Partner in same bed</b> |
|---------------------------------------------|------------------------------------|----------------------------------------|-----------------------------------------------|----------------------------|
| 10. Do you have a bed partner or room mate? | <input type="checkbox"/>           | <input type="checkbox"/>               | <input type="checkbox"/>                      | <input type="checkbox"/>   |

| <b>If you have a room-mate or partner, ask him/her how often in the past month you have had...</b> |                                  |                              |                             |                                   |
|----------------------------------------------------------------------------------------------------|----------------------------------|------------------------------|-----------------------------|-----------------------------------|
|                                                                                                    | <b>Not during the past month</b> | <b>Less than once a week</b> | <b>Once or twice a week</b> | <b>Three or more times a week</b> |
| a. loud snoring                                                                                    | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>    | <input type="checkbox"/>          |
| b. long pauses between breaths while asleep                                                        | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>    | <input type="checkbox"/>          |
| c. legs twitching or jerking while asleep                                                          | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>    | <input type="checkbox"/>          |
| d. episodes of disorientation or confusion during sleep                                            | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>    | <input type="checkbox"/>          |
| e. other restlessness while you sleep;<br>please describe                                          | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>    | <input type="checkbox"/>          |

## Appendix 2: PSQI scoring instructions

# PSQI

## Pittsburgh Sleep Quality Index

Name: \_\_\_\_\_ Date: \_\_\_\_\_

### Scoring Instructions

The Pittsburgh Sleep Quality Index (PSQI) contains 19 self-rated questions and 5 questions rated by the bed partner or roommate (if one is available). Only self-rated questions are included in the scoring. The 19 self-rated items are combined to form seven "component" scores, each of which has a range of 0-3 points. In all cases, a score of "0" indicates no difficulty, while a score of "3" indicates severe difficulty. The seven component scores are then added to yield one "global" score, with a range of 0-21 points, "0" indicating no difficulty and "21" indicating severe difficulties in all areas.

#### Component 1: Subjective sleep quality

Question #6 Score: \_\_\_\_\_

Component 1 score: \_\_\_\_\_

#### Component 2: Sleep latency

Step 1: Examine question #2 and assign scores as follows:

| Response:     | Score |
|---------------|-------|
| ≤ 15 minutes  | 0     |
| 16-30 minutes | 1     |
| 31-60 minutes | 2     |
| > 60 minutes  | 3     |

Question #2 Score: \_\_\_\_\_

Step 2: Question #5a Score: \_\_\_\_\_

Question #5a Score: \_\_\_\_\_

Step 3: Add #2 score and #5a score: \_\_\_\_\_

Sum of #2 and #5a: \_\_\_\_\_

Step 4: Assign component 2 score as follows:

| Sum of #2 and #5a | Component 2 Score |
|-------------------|-------------------|
| 0                 | 0                 |
| 1-2               | 1                 |
| 3-4               | 2                 |
| 5-6               | 3                 |

Component 2 score: \_\_\_\_\_

#### Component 3: Sleep duration

Examine Question #4 and assign scores as follows:

| Response: | Component 3 Score |
|-----------|-------------------|
| > 7 hours | 0                 |
| 6-7 hours | 1                 |
| 5-6 hours | 2                 |
| < 5 hours | 3                 |

Component 3 score: \_\_\_\_\_

#### Component 4: Habitual sleep efficiency

Step 1: Answer to question #4: \_\_\_\_\_

Question #4: \_\_\_\_\_

Step 2: Calculate the number of hours spent in bed (subtract #1 from #3)

Getting up time (Question #3) \_\_\_\_\_

Bedtime (Question #1) \_\_\_\_\_ -

Number of hours spent in bed \_\_\_\_\_

Step 3: Calculate Habitual Sleep Efficiency (HSE)

(Number of hours slept / (divided by) Number of hours spent in bed) X (multiplied by) 100 = HSE (%)

Step 4: Assign scores as follows:

| HSE %: | Component 4 Score |
|--------|-------------------|
| > 85%  | 0                 |
| 75-84% | 1                 |
| 65-74% | 2                 |
| < 65%  | 3                 |

Component 4 score: \_\_\_\_\_

# PSQI

## Pittsburgh Sleep Quality Index

Name: \_\_\_\_\_ Date: \_\_\_\_\_

### Component 5: Sleep disturbances

Step 1: Examine question #5b to #5j and write down scores:

#5b \_\_\_\_\_ #5e \_\_\_\_\_ #5h \_\_\_\_\_  
 #5c \_\_\_\_\_ #5f \_\_\_\_\_ #5i \_\_\_\_\_  
 #5d \_\_\_\_\_ #5g \_\_\_\_\_ #5j \_\_\_\_\_

Step 2: Add the scores for questions #5b to #5j:

Sum of #5b to #5j: \_\_\_\_\_

Step 3: Assign component 5 score as follows:

| Sum of #5b to #5j | Component 5 score |
|-------------------|-------------------|
| 0                 | 0                 |
| 1-9               | 1                 |
| 10-18             | 2                 |
| 19-27             | 3                 |

Component 5 score: \_\_\_\_\_

### Component 6: Use of sleeping medication

Question #7 Score: \_\_\_\_\_

Component 6 score: \_\_\_\_\_

### Component 7: Daytime dysfunction

Step 1: Add Question #8 en Question #9 scores:

Question #8 \_\_\_\_\_  
 Question #9 \_\_\_\_\_ +  
 Sum of #8 en #9 \_\_\_\_\_

Step 2: Assign component 7 score as follows:

| Sum of #8 and #9 | Component 7 score |
|------------------|-------------------|
| 0                | 0                 |
| 1-2              | 1                 |
| 3-4              | 2                 |
| 5-6              | 3                 |

Component 7 score: \_\_\_\_\_

### Global PSQI score

Add the seven component scores:

Global PSQI score: \_\_\_\_\_

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Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28(2), 193–213. [https://doi.org/10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4)

## **Appendix 3: Synopsis**

### **Title: Assessment of Sleep Quality Among Type 2 Diabetes Mellitus Patients**

#### **Introduction**

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and impaired glucose regulation. Sleep plays a crucial role in overall health, and there is growing evidence suggesting a bidirectional relationship between T2DM and sleep disturbances. This study aims to assess the sleep quality among individuals with T2DM to better understand the impact of diabetes on sleep and identify potential areas for intervention.

#### **Objectives**

- To evaluate the sleep quality of individuals diagnosed with Type 2 Diabetes Mellitus.
- To explore the prevalence of sleep disturbances, including sleep duration, and sleep efficiency, among T2DM patients.

#### **Methods**

**Participants:** The study will include a sample of adult individuals diagnosed with Type 2 Diabetes Mellitus.

**Study Design:** A cross-sectional observational study design will be employed to assess sleep quality among T2DM patients.

#### **Data Collection**

**Sleep Quality Assessment:** Participants will be asked to complete validated sleep quality questionnaires such as the Pittsburgh Sleep Quality Index (PSQI) to measure overall sleep quality.

**Demographic and Clinical Data:** Participants will provide information on age, gender, duration of diabetes, medication usage, and comorbidities.

#### **Data Analysis**

Statistical analyses, including descriptive statistics and inferential tests (e.g., chi-square tests) will be conducted to explore associations between sleep quality, and other relevant variables.

#### **Significance**

This study aims to contribute to the understanding of the relationship between T2DM and sleep quality. The findings may have implications for healthcare professionals in designing targeted interventions to improve sleep quality and overall well-being in individuals with Type 2 Diabetes Mellitus. Improved sleep quality could potentially lead to better diabetes management and overall health outcomes.

## Appendix 4: Plagiarism report

| ASSESSMENT OF THE SLEEP QUALITY AMONG TYPE 2 DIABETES MELLITUS PATIENTS |                                                                                                                                                                                                                                       |              |                |
|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
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