

# Sleep Quality and its Correlation with Glycosylated Hemoglobin Level among Patients with Type 2 Diabetes Mellitus

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## Abstract

**Aim:** The aim was to assess the sleep quality and its correlation with glycosylated hemoglobin level among patients with type 2 diabetes mellitus.

**Background:** A systematic review and meta-analysis on impact of sleep amount and sleep quality on glycemic control, including 70,000 type 2 diabetes mellitus patients with 20 studies, revealed that there was 23% increase in HbA1c level in patients who reported insufficient sleep duration <4.5–6 h/night.

**Methods:** A correlational research design was used. The sample consisted of 120 adults with type 2 diabetes mellitus attending non-communicable disease clinics of a rural and urban Health Training Center in Alappuzha. Socio-personal and clinical data were collected by interviewing the participants. Pittsburgh Sleep Quality Index (PSQI) scale used for assessing subjective sleep quality. The glycosylated hemoglobin level of the patients was estimated.

**Results:** It was found that 63.3% of patients with type 2 diabetes mellitus had poor sleep quality. There was a moderate positive correlation ( $r = +0.651$   $P < 0.01$ ) between sleep quality and glycosylated hemoglobin level among patients with type 2 diabetes mellitus. Out of seven domains in PSQI scale, six domains had positive correlation with glycosylated hemoglobin level.

**Conclusion:** It can be concluded that it is imperative to assess sleep in all patients with type 2 diabetes mellitus to identify and address poor glycemic control and this can, in turn, help to improve the quality of life of patients with type 2 diabetes mellitus.

**Keywords:** Glycemic control, Sleep quality, Type 2 diabetes mellitus

## INTRODUCTION

Forty percentage of people aged 40–59 reported that they are getting <6 h of sleep.<sup>[1,2]</sup> Worldwide, about 20–30% of general population is estimated to have various types of sleep disorders.<sup>[3]</sup>

India had more diabetics than any other country in the world, according to the International Diabetes Foundation, there were over 72 million cases of diabetes in India in 2017.<sup>[4]</sup> According

to the Indian Heart Association, India is projected to be home to 109 million individuals with diabetes by 2035.<sup>[5]</sup>

Kerala is considered as the diabetes capital of India. Only one-fifth of the diabetics are treated and adequately controlled. In Kerala, the prevalence of diabetes is as high as 20%, double the national average of 8%.<sup>[6]</sup> The study of Life Style Diseases in Central Kerala (SLICK), 10 year prospective cohort study done by Medical Trust Hospital and Diabetes Care Center, Pathanamthitta showed that the cumulative incidence of type 2 diabetes mellitus in Kerala is 21.9% and the incidence of prediabetes is 36.7%.<sup>[7]</sup> According to the Center for Disease Control, lack of sleep can lead to major health issues, these diseases include diabetes, cardiovascular disease, obesity, and depression.<sup>[8]</sup> Evidence showed that poor sleep quality among people with type 2 diabetes mellitus is associated with longer duration of diabetes, poor glycemic control (Glycosylated hemoglobin level of > 7%), normal body mass index, and

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hypertension.<sup>[9]</sup> Most of the studies regarding the relationship between sleep quality and glycemic control were held in the USA and Europe, and it is not clear whether the results are applicable to the Asian population.<sup>[10]</sup> There is less number of studies regarding the relationship between sleep quality and glycemic control, especially in India and in Kerala. Most of the studies suggested for further research.<sup>[11]</sup> The number of patients who were registered in non-communicable disease (NCD) clinic of Ambalappuzha south panchayath, including four subcenters was approximately 1800. More than 50% of patients came for the treatment of type 2 diabetes mellitus. A survey conducted by the investigator in Ambalappuzha south panchayath, during the clinical posting, found that 30% of persons above 40 years were diabetic and their routine blood glucose estimation were not normal. Majority of them reported that they were also having sleep disturbances. Hence, a study was conducted to determine the correlation between sleep quality and glycosylated hemoglobin level among patients with type 2 diabetes mellitus. The theoretical framework of the study was based on Nola J Pender's Health Promotion Model.

### Aim

The aim of this study was to assess the correlation between sleep quality and glycosylated hemoglobin level among patients with type 2 diabetes mellitus.

### Objectives

The objectives of this study were as follows:

1. To assess the sleep quality among patients with type 2 diabetes mellitus.
2. To assess the correlation between sleep quality and glycosylated hemoglobin level among patients with type 2 diabetes mellitus.

## MATERIALS AND METHODS

### Research approach and design

A quantitative approach with a correlational research design was adopted for the study. Adults with type 2 diabetes mellitus attending NCD clinics of Rural Health Training Centre (RHTC), Chettikadu and Urban Health Training Centre (UHTC), Ambalappuzha during the study period were included in the study. Through multistage sampling 120 patients (60 each from one NCD clinic) were selected consecutively as per the inclusion and exclusion criteria. Adults with type 2 diabetes mellitus who were taking treatment for at least 1 year and who can read and understand Malayalam were included in the study. Adults with type 2 diabetes mellitus who had debilitating illness, had blood transfusion within the last 3 months, who were on antipsychotics, who had any psychological disruption within previous 3 months, who were taking steroid drugs, and who reported any problems with vision were excluded from the study.

### Settings of the study

The study was conducted in the NCD clinics of Rural Health Training Center, Chettikadu and Urban Health Training Centre, Ambalappuzha.

### Population

In the present study, the population comprised 120 adults with type 2 diabetes mellitus attending NCD clinics of Alappuzha district.

### Sample

This study was adults with type 2 diabetes mellitus attending NCD clinics of RHTC, Chettikadu and UHTC, Ambalappuzha during the study period.

### Sampling technique

Sampling technique used is Multi Stage Random Sampling, that is, patients with type 2 diabetes mellitus who were fulfilling inclusion and exclusion criteria were selected as study sample.

### Description of the tools

The following tools were used to collect the data for finding the correlation between sleep quality and glycosylated hemoglobin level among patients with type 2 diabetes mellitus.

Tool 1: Socio-personal and clinical data sheet. It consisted of two sections

Section A: Socio-personal data

Section B: Clinical data

Technique: Interview, Bio-physiological measurement, and High profile liquid chromatography (HPLC)

Tool 2: Pittsburgh Sleep Quality Index (PSQI) scale for assessing sleep

quality of patient with type 2 diabetes mellitus.

Technique: Self-report

PSQI is a standardized self-report questionnaire that assesses sleep quality over a 1-month time interval consisting of 19 items. The component scores consist of subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each item is weighted on a 0–3 interval scale. The global PSQI score is then calculated by totaling the seven component scores, providing an overall score ranging from 0 to 21, where lower scores denote a healthier sleep quality. Grading is done as  $\leq 5$  – good sleep quality and  $> 5$  – poor sleep quality.

### Reliability of tool

The reliability of Pittsburgh Sleep Quality Index (PSQI) scale was checked by test retest method and by calculating Cronbach's Alpha ( $\alpha$ ). It was found to be 0.738. Hence, the tool was found to be reliable.

### Ethical consideration

Ethical clearance was given by Scientific Review Committee and Institutional Ethics Committee of Government College of Nursing Alappuzha, Kerala University of Health sciences, Thrissur, District Medical Officer, Alappuzha, Administrative Medical Officers of UHTC Ambalappuzha and RHTC

Chettikadu. Written informed consent was taken from each study subject.

### Pilot study

Pilot study was conducted among 12 patients with type 2 diabetes mellitus. The methodology and the tools were found to be appropriate and feasible.

### Data collection

The socio-personal and clinical data were collected by interviewing the patients. PSQI scale was used to measure the sleep quality of the patients by self-report. The glycosylated hemoglobin level was assessed by bio-physiological measurement and HPLC. The blood sample for glycosylated hemoglobin level estimation was collected as per the WHO guidelines with universal precautions. Collected blood samples were transported to the private laboratory (with NABL accreditation) for the estimation of glycosylated hemoglobin level. For the transportation, it took around 45 min from RHTC, Chettikadu and 10 min from UHTC, Ambalappuzha. The results were obtained from the laboratory on the same day itself. Confidentiality of the data was maintained.

## RESULTS

The data interpreted based on objectives of the study using descriptive and inferential statistics. Analysis was done using SPSS 20. Socio-personal and clinical data were analyzed using frequency distribution and percentage. The correlation between sleep quality and glycosylated hemoglobin level was analyzed using Karl Pearson correlation test.

### Results were organized under following headings

#### Section 1: Socio-personal and clinical data

The socio-personal and clinical data are presented in Table 1. Majority of the patients were aged 56–70 years (59.2%), were female (55.8%), had primary education (59.2%), were non-alcoholics (75%), and non-smokers (63.3%), had no family history of diabetes mellitus (58.3%), and were taking oral hypoglycemic agents (79.2%). Majority had comorbidities (51.7%), of which hypertension and dyslipidemia were most common (30.6%). As shown in Table 2, 76.7% of the patients were not doing any type of exercise. Regarding the sleep habits, most of the patients (39.2%) were not having any routines before sleep.

Table 3 shows that the mean and standard deviation of the glycosylated hemoglobin of the patients were 7.83 and 1.72.

It is from Table 4 that majority (32.5%) of the patients were having poor control (level > 8.5%) of their glycosylated hemoglobin level.

#### Section 2: Sleep quality of patients with type 2 diabetes mellitus

Mean and standard deviation of sleep quality scores among patients with type 2 diabetes mellitus were 7.7 and 3.81. From Table 5, it is seen that majority of the patients (63.3%) had poor sleep quality (score > 5) based on the PSQI.

#### Section 3: Correlation between sleep quality and glycosylated hemoglobin level among patients with type 2 diabetes mellitus

There was significant positive correlation between sleep quality and glycosylated hemoglobin with  $r$  value of + 0.651. It can be interpreted that as the sleep quality scores increase (poor quality), there was an increase in the glycosylated hemoglobin among patients with type 2 diabetes mellitus. The correlation between different domains of sleep quality and glycosylated hemoglobin is shown in Table 6. None of the patients were having sleeping medication. Hence, component 6 of the scale was not included for correlation.

**Table 1: Socio-personal and clinical data of patients with type 2 diabetes mellitus ( $n=120$ )**

Variable	Categories	%
Age (year)	<40	1.7
	40–55	30
	56–70	59.2
	71–85	9.1
Gender	Male	44.2
	Female	55.8
Education	Primary education	59.2
	High school education	36.6
	Intermediate/Diploma	4.2
Status of smoking	Patients who had habit of smoking	26.7
	Non-smoker	63.3
	Smoker	10
Status of alcoholism	Patients who had habit of alcoholism	20.8
	Non-alcoholic	75
	Alcoholic	4.2
Family history of Type 2 diabetes mellitus	No	58.3
	Yes	41.7
Type of treatment	Oral hypoglycemic agent	79.2
	Insulin therapy	0
	Both (OHA and Insulin)	20.8
Blood glucose level	Normal	54.2
	Abnormal	45.8
Co-morbidity	No	48.3
	Yes	51.7
Glycosylated hemoglobin level	Good control (<6.5%)	28.3
	Fair control (6.5–7.5%)	20
	Unsatisfactory control (7.5–8.5%)	19.2
	Poor control (>8.5%)	32.5

**Table 2: Frequency distribution and percentage of patients with type 2 diabetes mellitus based on type of exercise ( $n=120$ )**

Type of exercise	F	%
Swimming	2	1.7
Gardening	1	0.8
Cycling	4	3.3
Brisk walking	21	17.5
None	92	76.7

**Table 3: Mean and standard deviation of glycosylated hemoglobin among patients with type 2 diabetes mellitus ( $n=120$ )**

Variable	Mean	SD	Maximum	Minimum
Glycosylated hemoglobin	7.83	1.72	12	5

## DISCUSSION

In the present study, 28.3% of patients had good glycemic control (glycosylated hemoglobin level  $<6.5\%$ ). A study done in University of Chicago Hospital to identify the relationship between sleep disturbance and glycemic control among patients with type 2 diabetes mellitus showed that 26% of patients with type 2 diabetes mellitus had glycosylated hemoglobin level  $<6.5\%$ .<sup>[12]</sup>

From the present study, it was found that 63.3% of patients had poor sleep quality (PSQI  $\geq 5$ ). The study done on role of sleep duration and quality in the risk and severity of type 2 diabetes mellitus done in China reported that 71% of patients exceed the cutoff for poor sleep quality (PSQI  $\geq 5$ ).<sup>[13]</sup>

In the present study, there was a significant moderate positive correlation ( $r = +0.651$ ,  $P < 0.01$ ) between sleep quality and glycosylated hemoglobin level among patients with type 2 diabetes mellitus. A study done in Chicago supported the observation of present study by reporting a positive correlation

( $r = +0.48$ ,  $P < 0.02$ ) between glycosylated hemoglobin level and PSQI score.<sup>[14]</sup> Contrary to that another study done in Ramachandra University, Chennai, Tamilnadu, India, revealed that there was no significant correlation between sleep quality and glycosylated hemoglobin level.<sup>[15]</sup>

The present study revealed that there was a significant moderate positive correlation ( $r = +0.411$ ,  $P < 0.01$ ) between score of sleep duration and glycosylated hemoglobin level among patients with type 2 diabetes mellitus. A study conducted at Mahidol University, Bangkok, Thailand revealed that sleep duration and glycosylated hemoglobin level were inversely correlated ( $r = -0.265$ ,  $P < 0.026$ ).<sup>[16]</sup>

## CONCLUSION

The findings showed that there is a significant moderate positive correlation between sleep quality and glycosylated hemoglobin level among patients with type 2 diabetes mellitus. The six domains of sleep quality also had significant positive correlation with glycosylated hemoglobin level. The glycosylated hemoglobin level can be reduced by improving the sleep quality of patients with type 2 diabetes mellitus.

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## CONFLICTS OF INTEREST

Not declared.

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Self.

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**Table 4: Frequency distribution and percentage of patients with type 2 diabetes mellitus based on glycosylated hemoglobin level (n=120)**

Glycosylated hemoglobin level	f	%
Good control ( $<6.5\%$ )	34	28.3
Fair control ( $6.5-7.5\%$ )	24	20
Unsatisfactory control ( $7.5-8.5\%$ )	23	19.2
Poor control ( $>8.5\%$ )	39	32.5

**Table 5: Frequency distribution and percentage of patients with type 2 diabetes mellitus based on sleep quality (n=120)**

Sleep quality	F	%
Good sleep quality ( $<5$ )	44	36.7
Poor sleep quality ( $\geq 5$ )	76	63.3

**Table 6: Correlation between glycosylated hemoglobin level and six domains of PSQI scale (n=120)**

Seven domains of PSQI	r value	P value	Correlation status
Subjective sleep quality ***Significant at 0.001 level	0.517***	0.0001	Moderate positive correlation ( $r = +0.517$ )
Sleep latency **Significant at 0.01 level	0.443**	0.005	Moderate positive correlation ( $r = +0.443$ )
Sleep duration **Significant at 0.01 level	0.411**	0.002	Moderate positive correlation ( $r = +0.411$ )
Sleep efficiency ***Significant at 0.001 level	0.444***	0.000	Moderate positive correlation ( $r = +0.444$ )
Sleep disturbance ***Significant at 0.001 level	0.434***	0.0001	Moderate positive correlation ( $r = +0.434$ )
Daytime dysfunction ***Significant at 0.001 level	0.553***	0.0001	Moderate positive correlation ( $r = +0.553$ )

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