

## Original Research Article

# Effect of sleep duration and quality in the severity of type 2 diabetes mellitus in Indians

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### ABSTRACT

**Background:** Rapid urbanization has caused increase in the incidence of Diabetes and Sleep debt. This study is intended to see any correlation between Diabetes and sleep quality.

**Methods:** Diabetes subjects who had their HbA1c done in the past three months were enrolled and their sleep was studied using Pittsburgh sleep quality index (PSQI) which is simple, reliable epidemiological tool with high sensitivity and specificity. Subjects with chronic pain were excluded.

**Results:** The mean PSQI score of males was more than that of female which was statistically insignificant. Urban diabetes subjects had a higher PSQI score than rural subjects. Pearson correlation ( $r$ ) was 0.22 for HbA1c and PSQI score which was statistically significant with  $p=0.04$ . Though the subjects with less than 5 hours of sleep had a higher HbA1c compared to those with more than 5 hours of sleep this was statistically insignificant.

**Conclusions:** This study showed positive correlation between sleep quality and Diabetes.

**Keywords:** Diabetes, Pittsburgh sleep quality index, Sleep duration, Sleep quality

### INTRODUCTION

Chronic partial sleep loss due to bedtime restriction, night life, night traffic noise, night shift duties and sleep complaints are increasingly prevalent in modern society.<sup>1</sup> Recent evidence from laboratory and epidemiologic studies has accumulated, suggesting that decreased sleep duration and/or quality may adversely affect glucose regulation and increase the risk of type 2 diabetes mellitus.<sup>2</sup> Currently, India is world capital city of diabetes. Also, there is rapid urbanization because of which lifestyle has changed. Sleep duration and quality has reduced. Is there a correlation between increase in prevalence of diabetes and sleep duration, pattern and quality of sleep?

Aims and objectives of this study was to assess the relation between duration of sleep with severity of diabetes.

### METHODS

Eighty-five Type 2 Diabetes mellitus patients who are above the age of 20 years and less than 65 years were selected for the study. Patients who had incomplete response to the questionnaires, Diabetes of less than one year duration, Patients who claim sleep of more than 12 hours, Patients without HbA1c within 3 months were excluded. PSQI question "how often have you had trouble sleeping because you had pain?" identifies patients with sleep disturbed by pain as those who

respond “3 or more times per week.” Authors excluded these individuals in our analyses of the association between sleep and glycemic control because chronic pain is a likely confounder.

The study involved 30- to 45-minute of interview. Written informed consent was taken. During the interview, anthropometric values were taken and the questions on diabetes and its complications were asked. Diabetes medications, the presence of major complications of diabetes (neuropathy, retinopathy, nephropathy, coronary artery disease, and peripheral vascular disease) were assessed. The interview included the Pittsburgh Sleep Quality Index (PSQI), 26 a validated 19-item questionnaire that produces a global sleep quality score that ranges from 0 to 21, derived from 7 component scores. A global score greater than 5 distinguishes poor sleepers from good sleepers.

The question “how often have you had trouble sleeping because you had pain?” identified patients with sleep disturbed by pain as those who responded “3 or more times per week.” Authors exclude these individuals in our analyses of the association between sleep and glycemic control because chronic pain is a likely confounder. Correlation analysis and regression analysis were used for the statistical analysis. Ethical committee clearance was taken. Informed consent was taken.

### Statistical methods

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. The following assumptions on data is made, Assumptions: 1. Dependent variables should be normally distributed, 2. Samples drawn from the population should be random, Cases of the samples should be independent

Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients, Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis. Fisher Exact test used when cell samples are very small.

Pearson correlation between study variables is performed to find the degree of relationship, Pearson correlation coefficient ranging between -1 to 1, -1 being the perfect negative correlation, 0 is the no correlation and 1 means perfect Positive correlation.

### Statistical software

The Statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

## RESULTS

About eighty-five subjects were selected after they met inclusion and exclusion criteria. As authors see from Table 1 the mean age of the subjects was 49.42±10.67 years. The study included 57 (67%) males and 28 (33%) females.

**Table 1: Demographic profile of study participants.**

Demographic profile	Mean±SD
Age in years	49.42±10.67
WC in cms	98.40±10.13
WHR	0.97±0.095
BMI kg/m <sup>2</sup>	26.81±5.01
FBS mg/dl	177.06±62.47
PPBS mg/dl	253.78±83.87
HbA1c %	8.25±1.56
PSQITOT	5.06±3.56

N= 85

The mean PSQI score for Men was 4.67±3.40 and that for women was 5.86±3.78. Though women had high mean PSQI score than men it was not statistically significant (p= 0.310). Among the participants 76% (N=65) were from urban area and 24 % (N=20) were from rural area. Participants from Urban area had PSQI score of 5.28±3.65 compared those from rural area PSQI of 4.35±3.23 which was statistically insignificant (p=0.453). The mean waist circumference (WC) was 98.40±10.13cms, mean waist -Hip ratio was 0.97±0.095 and mean body mass index (BMI) was 26.81±5.01 kg/m<sup>2</sup>. There mean FBS was 177.06±62.47 and PPBS was 253.78±83.87 mg%. The mean HbA1c was 8.25±1.56%. HbA1c ranged from 5.9% to 12.9%.

**Table 2: Pearson Correlation of PSQI.**

PSQI vs.	r value	P value
PSQI Total vs. FBS (mg/dl)	0.112	0.299
PSQI Total vs. PPBS (mg/dl)	0.098	0.363
PSQI Total vs. HbA1c%	.222	0.041

Authors then tried to correlate between the PSQI score a sleep quality index and HbA1c levels, Fasting blood sugar (FBS) and Postprandial blood sugar (PPBS). Pearson correlation coefficient was used to find out the correlation (Table 2). The Pearson Coefficient ‘r’ for FBS was 0.112 and for PPBS it was 0.098. Indicating that FBS correlated comparatively better than PPBS. But this Correlation was statistically insignificant for Both FBS (p=0.299) and PPBS (p=0.363). But the r value for

correlation between HbA1c and PSQI score was 0.222 with P value of 0.041, indicating that HbA1c value had a significant correlation with HbA1c.

**Table 3: Comparison of variables for Poor sleepers vs. good sleepers.**

Parameters	Good sleepers PSQI ≤5 N=49	Poor sleepers PSQI >5 N=36	p value
Age	49.00±10.42	50.00±11.11	0.672
WC	98.112±9.40	98.80±11.17	0.757
WHR	0.97±0.09	0.97±0.09	0.803
BMI	26.66±3.76	27.01±6.37	0.756
FBS	173.35±67.83	182.11±54.86	0.526
PPBS	257.12±97.31	249.22±62.0	0.670
HBA1C	8.07±1.60	8.49±1.49	0.217

Authors then looked into whether the poor sleepers, who have PSQI score greater than 5 are having high HbA1c compared to good sleepers, who have PSQI score equal to or lesser than 5 (Table 3). The mean HbA1c of poor sleepers was 8.49±1.49 whereas that of good sleepers was 8.07±1.60. Though poor sleepers had a high HbA1c, this was statistically insignificant (p=0.217). The participants were divided according to duration of sleep into 4 groups (Table 4). Those with sleep duration of more than 7 hours as 0, between 6-7 hours as 1, between 5-6 hours as 2 and those with less than 5 hours as 3. Then authors looked for mean HbA1c value of each group.

The mean HbA1c of group 0 was 8.04±1.64, group 1 was 8.26±1.20, group 2 was 8.85±1.90 and group 3 was 8.67±0.75. As authors can see subject with more than 7 hours of sleep had a lower HbA1c than those with less hours of sleep. But this difference was statistically insignificant with p=0.475.

**Table 4: Comparison of HbA1c according to duration of sleep of patients studied.**

Duration of sleep	0	1	2	3
Mean±std. dev.	8.04± 1.64	8.26±1.20	8.85±1.90	8.67±0.75
N	47	21	13	4
P value	0.475			

## DISCUSSION

Two laboratory experimental studies have reported altered glucose regulation during sleep restriction. In one study, restriction to 5 days of 4-hour sleep durations was associated with a 40% reduction in tolerance to glucose given intravenously and a 30% reduction in the acute insulin response.<sup>2</sup> These findings were confirmed in another randomized cross-over study that used 2 nights of sleep restriction or extension (4-hour vs. 10-hour bedtimes).<sup>3</sup> After the second night of each condition, caloric intake was replaced by constant intravenous glucose infusion, and blood samples were collected every 20 minutes.

After sleep restriction, morning glucose levels were higher and insulin levels were lower than after sleep extension.<sup>3</sup> Preliminary data from an ongoing study revealed a marked reduction in glucose tolerance and insulin sensitivity after 8 nights of 5-hour bedtimes compared with 8-hour bedtimes.<sup>4</sup>

The consistency of these findings, despite differences in experimental design, suggests that sleep restriction has adverse effects on glucose metabolism. The rapidly accumulating evidence for a relationship between impaired sleep and diabetes risk raises the possibility that an association between reduced sleep duration or quality

and the severity of an existing diabetic condition may exist.

The Pittsburgh sleep quality index was developed with several goals. It provides a reliable, valid and standardized measure of sleep quality. It can also discriminate between good and poor sleepers. It is good epidemiological tool for researchers. It is easy to use and understand. The PSQI global score has the advantage of giving single overall assessment of sleep quality, being simple to calculate, and allowing for direct comparison of individual of patients or groups.<sup>5</sup>

The A1C assay is widely accepted and used as the most reliable means of assessing chronic glycemia.<sup>6</sup> Normally, glycemic control is assessed by the measurement of glycated hemoglobin (i.e., HbA1c) with a normal level of <5.7%, a prediabetes level of 5.7-6.4%, a diabetes level of ≥ 6.5%, and a target level for good glycemic control of <7% in patients with diabetes.<sup>7</sup>

Hence, Severity of diabetes is assessed by HbA1c. The present study tried to at the effect of sleep quality and duration on the Diabetes in Indians. Authors used PSQI scoring which is internationally accepted simple questionnaires with high sensitivity and specificity tool. This scoring system for sleep can be used for epidemiological survey.

The study showed that urban diabetes subjects have high PSQI score compared to Rural Diabetes subjects. This could be because of poor sleep in urban population because of late night life and increased Air pollution leading to disturbed sleep. On gender based analysis, Men had a poor sleep quality, high PSQI score and high HbA1c. This could be because of night shifts in works and late night life. But this Demographic and gender based difference in sleep quality was statistically insignificant.

The present study shows that there is statistically significant ( $p=0.041$ ) correlation between sleep quality as measured by PSQI score and HbA1c with  $r=0.222$ . The  $r$  value of 0.22 indicate low association, but this could be because of smaller sample size in our study. Poor sleeper with PSQI score greater than 5 had a high HbA1c than good sleeper, though this was statistically insignificant. A similar study done in Taiwan showed a positive correlation between sleep quality and HbA1c with  $r$  value of 0.5.<sup>8</sup> Another study done in Chicago with 161 participants showed positive correlation ( $r=0.28$ ) with HbA1c.<sup>9</sup>

In the present study subjects with less than 5 hours of sleep had a statistically insignificant high HbA1c compared to those with little longer duration of sleep. Indicating that sleep debt may lead to Diabetes and higher HbA1c level. A study done by Ayas et al, showed a similar association between duration of sleep and Diabetes.<sup>10</sup>

Smaller sample size was the limitation of the present study. Gender and Demographical distribution were Unequal.

## CONCLUSION

The present shows that there is correlation between Diabetes and Sleep quality and duration. Sleep debt can lead to Diabetes and associated insulin resistance and thus metabolic syndrome.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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