Association of Subjective Sleep Quality and Glycemic Level in Patients with Type 2 Diabetes Mellitus: A cross sectional study

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ABSTRACT

Background

Sleep disorders are considered as one of the important risk factor which have a great impact on patients with type 2 diabetes mellitus.

Objective

The objectives of this study was to determine the effect of sleep quality on the glycemic level among type 2 diabetic patients.

Method

This was a cross sectional study done in 208 type 2 diabetic patients visiting Kathmandu Medical College Public Limited from July 2019 to December 2019. Data regarding sleep quality was collected by using Pittsburgh Sleep Quality Index taking global cut off score ≥ 8 as poor sleeper. Glycated hemoglobin level ≥ 7 was considered as poor glycemic control. Chi square test was used to compare parameters between good sleeper and poor sleeper. Independent sample t test compared the means of Pittsburgh Sleep Quality Index factors and glycemic contol. A logistic regression analysis of Pittsburgh Sleep Quality Index factors and glycated hemoglobin was done. Values of $p \leq 0.05$ were considered statistically significant.

Result

The study findings revealed that 62 % had poor glycemic control and 58.7 % were poor quality sleeper. There was a significant association of sleep quality with glycemic control and duration of diabetes. Logistic regression analyses showed that subjective sleep quality was risk factor for poor glycemic control. The odds ratio for subjective sleep quality was found to be 4.59 (2.13-9.91).

Conclusion

Poor sleep quality was common in type 2 diabetic patients. This study showed that the risk factors for poor subjective sleep quality include poor glycemic control and longer duration of diabetes mellitus.

KEY WORDS

Diabetes mellitus, Glycemic level, Sleep

INTRODUCTION

Sleep is a basic biologic function which is vital for good health and quality of life.[1] Poor sleep and insomnia with short sleep duration are associated with an increased risk of diabetes mellitus (DM).[2]

People with impaired sleep quality or sleep quantity will experience reduction in the insulin sensitivity which is followed by increase in blood glucose level.[3] The study done by Jemere et al. reported poor glycemic control as the independent predictor of poor sleep quality among diabetics.[4] Another study have identified that decrements in sleep quality may increase the severity of type 2 DM.[5]

Sleep disorder is considered as an emerging risk factor for diabetes as it plays a pivotal role in the occurrence of diabetes through neurometabolic pathway. During sleep deprivation cortisol level rises which consequently inhibits insulin secretion and may result in diabetic states in long run.[6] Leproult et al. reported alterations in cortisol levels following the night of sleep deprivation.[7] Association between serum cortisol levels and insulin secretion was assessed in a population-based study among 1071 Japanese individuals which showed the correlation between serum cortisol levels and insulin secretion after adjustment for fasting blood glucose.[8]

In Nepal, diabetes is one of the most important health concerns with a prevalence of 8.4%.[9] The aim of this study is to determine the effect of sleep quality on glycemic level in diabetic patients.

METHODS

This was a cross sectional study carried out in the medicine out patient department of Kathmandu Medical College and Teaching Hospital, Sinamangal during the period from July 2019 to December 2019. Non-probability purposive sampling technique was employed and the sample size was calculated based on prevalence of 84% with 95% confidence interval.[10]

Data was collected using a pretested questionnaire in two sections. The first section included baseline information such as age, gender, occupation, level of education, duration of diabetes mellitus, type of treatment. The second part consisted of the Pittsburgh sleep quality index (PSQI) which is a standard measure to assist sleep quality among diabetic patients. PSQI is a self-rating scale developed by Buysse et al., in 1989. The PSQI is a score consisting of nine questions which evaluate different factors correlated to sleep quality in the preceding month. "The nine questions" were divided into "seven component scores," each one put on a "0-3 scale." The components of the PSQI are sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction. Each factor was scored from 0 to 3. The sum of the scores for the seven factors yields PSQI global score, which ranges from 0 to 21. Higher the PSQI global score, poorer the sleep quality. The cut-off PSQI score was ≥ 8, the sensitivity was 98.3%, and the specificity was 90.2%. Therefore, PSQI ≥ 8 was used as an indication of the presence of sleep disorder in this study.[3]

The ethical approval for the study was taken from Institutional Review Committee of Kathmandu Medical College Teaching Hospital, Sinamangal. The written informed consent was obtained from each participants. Patients above age 18, of either sex, diagnosed with type 2 DM were included. Patients presenting with acute complications of diabetes mellitus, patients with known history of severe or long term psychiatric illness were excluded from the study.

The data was entered and analyzed using the statistical Package for Social Science (SPSS version 22.0). Categorical variables was presented as frequencies and percentages. Continuous variables was presented as mean ± standard deviation. Chi square test was used to compare parameters between good sleeper and poor sleeper. Independent sample t test compared the means of PSQI factors and glycemic control. A logistic regression analysis model was established, using PSQI factor scores as independent variables and glycated hemoglobin (HbA1c) as dependent variables. Values of $p \leq 0.05$ were considered statistically significant.

RESULTS

A total of 208 participants were included in the study. The age range was from 30 to 78 years with mean age (55.36 ± 10.58). Majority (57.69%) of the patients were in the age group of 41 to 60 years. Most of the patients were female (54.8%). About 122 (58.7%) had duration of diabetes mellitus for more than 10 years. The glycemic control was

Table 1. Associated characteristics of the study population (n=208)

Parameter	Category	Frequency	Percentage (%)
Age	21-40	19	9.13
	41-60	120	57.69
	61 and above	69	33.17
Gender	Male	94	45.2
	Female	114	54.8
Sleep pattern	Poor	122	58.7
	Good	86	41.3
Glycemic control	Good control	79	38
	Poor control	129	62
Duration of DM	< 10 years	86	41.3
	≥ 10 years	122	58.7
Type of treatment	OHA	141	67.8
	OHA and Insulin	32	15.4
	Insulin	35	16.8

Note: Oral hypoglycemic agents (OHA)

good in 38% and remaining 62% had poor glycemic control. The sleep pattern was poor in 58.7% patients.

Based on the HbA1c level, patients were grouped into good glycemic control group (HbA1c <7) and poor glycemic control group (HbA1c ≥7). There was significant associations of sleep quality with glycemic control (p=0.000) and duration of diabetes (p=0.003). Those diabetic patients on oral hypoglycemic agents (OHA) had significantly higher poor sleep quality. (Table 2)

Table 2. Effect of sleep quality on various parameters

Parameter	Sleep quality		Chi square	p value
	Poor	Good		
Gender				
Male	55 (45.1)	39 (45.3)	0.001	0.97
Female	67 (54.9)	47 (54.7)		
Glycemic control				
Good (HbA1c <7)	21 (17.2)	58 (67.4)	54.02	0.000
Poor (HbA1c ≥7)	101 (82.8)	28 (32.6)		
Duration of DM				
< 10 years	40 (32.8)	46 (53.5)	8.91	0.003
≥ 10 years	82 (67.2)	40 (46.5)		
Type of treatment				
OHA	89 (73)	52 (60.5)	10.37	0.006
OHA and Insulin	21 (17.2)	11 (12.8)		
Insulin only	12 (9.8)	23 (26.7)		

When comparing the individual PSQI factors between good glycemic control group and poor glycemic control group, all six PSQI factors, except for the "Daytime dysfunction" was found to be statistically significant. (Table 3)

Table 3. Comparison for PSQI scores of the good glycemic control and poor glycemic control patients

PSQI factors	Good glycemic control (n= 79)	Poor glycemic control (n=129)	p value
Subjective sleep quality	0.85 ± 1.01	1.85 ± 0.88	0.000
Sleep latency	0.78 ± 0.90	1.39 ± 0.78	0.000
Sleep duration	0.99 ± 0.91	1.60 ± 0.74	0.000
Sleep efficiency	1.11 ± 0.87	1.60 ± 0.72	0.000
Sleep disturbances	0.91 ± 0.64	1.18 ± 0.71	0.007
Use of sleeping medications	0.90 ± 0.69	1.24 ± 0.89	0.004
Daytime dysfunctions	0.73 ± 0.73	1.02 ± 0.99	0.029

Logistic regression analyses showed that subjective sleep quality was risk factor for poor glycemic control (HbA1c ≥7). The Odds ratio (OR) for subjective sleep quality was found to be 4.59 (2.13-9.91). (Table 4)

Table 4. Logistic regression analysis of the PSQI factors and glycemic control

PSQI factors	HbA1c ≥ 7 %				
	β value	SE	OR	95 % CI	p value
Subjective sleep quality	1.52	0.39	4.59	2.13-9.91	0.000
Sleep latency	-0.34	0.33	0.70	0.36-1.36	0.30
Sleep duration	-0.11	0.52	0.89	0.32-2.49	0.83
Sleep efficiency	-0.22	0.42	0.79	0.34-1.84	0.59
Sleep disturbances	-0.19	0.29	0.82	0.46-1.48	0.52
Use of sleeping medications	0.12	0.25	1.13	0.69-1.85	0.61
Daytime dysfunctions	-0.006	0.22	0.99	0.64-1.53	0.97

DISCUSSION

The present study investigated the sleep quality and glycemic level in patients with type 2 diabetes mellitus visiting a tertiary care teaching hospital. We used PSQI scores with cut off point global PSQI ≥8 for sleep evaluation. The prevalence of poor sleep pattern was found to be 58.7%. While the study done by Shamshigaran et al. with the cut off point PSQI >5, indicated that 38% of the patients were poor sleepers.[6] A higher prevalence of about 64% is reported in India with PSQI score ≥5.[11] Depending on PSQI score >8, Cappuccio et al. found that 47.1% of diabetic patients were poor sleepers.[12] This variation in the prevalence of poor sleep quality might be because of difference in the PSQI cut off score. The total mean PSQI score of our study was higher than that in these studies. The PSQI cut off score of 8 was proved to be a reliable and valid instrument, with 98.3% sensitivity and 90.2% specificity.[3]

Our study showed that 38% of diabetic patients had good glycemic control (HbA1c <7%). Whereas a study done by Ashenghiti et al. reported that only 22.7% had controlled diabetes.[13] A higher value of 53% was seen in study done by Kodakandle et al. in India.[11]

In this study we did not find association between gender and poor sleep quality. However one study reported that female patients were 1.6 times more likely to have poor sleep quality.[14] Similar to our finding, the study done by Rajendran et al found no association between gender and poor sleep quality.[15]

Our study showed that poor glycemic control group(HbA1c ≥7) had a significantly higher poor sleep quality. Similar findings were reported by these studies.[1,16] The cause of this might be due to the reasons that most diabetic patients suffer from painful diabetic neuropathy and osmotic symptoms resulting in frequent visit to bathroom during the night.[17,18] In a study conducted in Australia with 74 patients with type 2 DM, nocturia was correlated with sleep onset and maintenance difficulties.[19]

Our study revealed that diabetic patients with longer disease duration (≥ 10 years) had significantly higher prevalence of poor sleep quality than those with shorter duration of disease. Similar finding was seen in study done in Saudi Arabia.[13] Keinanen-Kiukaanniemi et al. argued that the duration of diabetes is a risk factor for poor quality of sleep.[20] This study showed that diabetic patients on oral

hypoglycemic agents (OHA) were more likely to have poor sleep quality as compared to patients receiving insulin only. This result is in disagreement to Cappuccio et al. which reported that insulin users complained of poor sleep quality more often than those on OHA use only.[12] Rajendran et al. did not found significant association between sleep quality and the type of treatment of diabetes.[15]

There was a statistically significant difference in the PSQI factors between patients with good glycemic control and those with poor glycemic control, except for "Daytime dysfunction". Whereas, in a study done by Zhu et al. all the PSQI factors except "use of sleeping medications" was found to be statistically significant.[3]

The logistic regression analysis of the PSQI factors and glycemic control showed only subjective sleep quality as the risk factor for poor glycemic control. The OR (95 % CI) is 4.59 (2.13-9.91). This values indicate that diabetic patients with poor glycemic control are 4.59 times more likely to have poor subjective sleep quality than those with good glycemic control. This is in contrast to the study done by Zhu et al. which reported sleep latency, sleep disturbance and daytime dysfunction as the risk factors for poor glycemic control.[3] Other study in Taiwan showed significant association of sleep quality and sleep efficiency with HbA1c.[21]

As the sleep quality parameters were evaluated by valid questionnaires, there was no objective measurement of the sleep. The cases included in the study may not be representative of Nepalese population. We did not take history regarding the breathing disorder that might have affected the sleep of diabetic patients.

CONCLUSION

The study findings concluded that the poor sleep pattern is prevalent in type 2 diabetes mellitus patients in our setting. Diabetic patients with poor glycemic control and those with longer duration of disease have significant poor sleep quality.

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