

Original Research Article

Factors influencing sleep quality and its impact on glycemc control in patients with type II diabetes mellitus - A hospital based cross sectional study

Krishna Kodakandla^{1*}, Gopinath Maddela², Mohammed Shahid Pasha³

¹Assistant Professor, Department of Psychiatry, Shadan Institute of Medical Sciences, Hyderabad, India

²Assistant Professor, Department of Internal Medicine, Shadan Institute of Medical Sciences, Hyderabad, India

³Intern, Shadan Institute of Medical Sciences, Hyderabad, India

*Corresponding author email: Krishna.kodakandla@gmail.com

	International Archives of Integrated Medicine, Vol. 3, Issue 5, May, 2016.	
	Copy right © 2016, IAIM, All Rights Reserved.	
	Available online at http://iaimjournal.com/	
	ISSN: 2394-0026 (P)	ISSN: 2394-0034 (O)
	Received on: 18-04-2016	Accepted on: 02-05-2016
	Source of support: Nil	Conflict of interest: None declared.
How to cite this article: Kodakandla K, Maddela G, Pasha MS. Factors influencing sleep quality and its impact on glycemc control in patients with type II diabetes mellitus - A hospital based cross sectional study. IAIM, 2016; 3(5): 138-145.		

Abstract

Background: The absolute number of diabetic population worldwide has raised from 108 million in 1980 to 422 million in 2014. Many western studies documented that diabetes affects the patient's sleep quality negatively and also imbalance in sleep quality considerably influences the adequacy of glycemc control. Little attention is given to this vital aspect in clinical care of diabetic population in India due to scarcity of studies on the subject.

Aim: To assess the prevalence of poor sleep quality and factors influencing it in type II diabetes mellitus patients and also to assess the impact of sleep quality on glycemc control.

Materials and methods: The study is a hospital based descriptive cross sectional study, conducted in a tertiary care teaching hospital. A total of 100 Patients of type II diabetes mellitus attending the study setting were recruited sequentially into the study. Sleep pattern was assessed by Pittsburg Sleep Quality Index (PSQI), a person with PSQI global score of 5 and above was considered as "poor sleeper". HbA1c level of ≥ 7 was considered as poor glycemc control as per Standards of Medical Care in Diabetes, 2016 guidelines.

Results: Sleep pattern (PSQI global score ≥ 5) was poor in 64% (54.2% to 72.7%) of the study subjects. The odds of poor glycemic control were 3.56 (95 % CI 1.47 to 8.60, p value 0.004) times higher in people with poor sleep quality, compared to people with good sleep quality. Multivariate logistic regression analysis showed higher risk of poor sleep with increasing age, male gender and combined insulin and OHA therapy. Diabetic neuropathy had the strongest association with poor sleep pattern, with an Odds ratio of 3.5 (95% CI 1.27 to 9.59, p value 0.05).

Conclusion: The prevalence of poor sleep quality is very high in diabetic patients and is strongly associated with diabetic neuropathy. Poor sleep quality is associated with poor glycemic control.

Key words

Diabetes mellitus, Sleep quality, Glycemic control.

Introduction

Diabetes has been found to be the commonest metabolic disorders among numerous populations' subgroups. A recent study assessing the worldwide trends in diabetes has reported that between 1980 and 2014 the age-standardized prevalence among men has increased from 4.3% to 9%, while its prevalence among women has raised from 5% to 7.9%. Over all the absolute number of diabetic population worldwide has raised from 108 million in 1980 to 422 million in 2014 [1].

Good quality sleep is significantly important in patients with chronic systemic conditions like diabetes mellitus (DM). Evidence shows that up to one third of patients with DM were affected with concomitant sleep disorders compared to less than one tenth of controls [2]. The exact prevalence of sleep disturbances among patients with type 2 diabetes reported by various studies ranges from 42 to 71% [3, 4]. These patients reportedly suffer from higher rates of daily sleepiness, obstructive sleep apnea and the resulting adverse consequences [5-8].

DM and sleep are reported to have bidirectional association. As many researchers have documented that Diabetes affects the patient's sleep quality negatively and also imbalance in sleep quality considerably influences the adequacy of glycemic control, which in turn can have harmful effect on patient's health related quality of life [9-13].

Various factors have been proposed to contribute to DM-related sleep problems. These include Overweight and obesity, sleep related respiratory disorders like OSA, pain and discomfort caused by diabetic neuropathy, poor bladder and bowel control due to autonomic neuropathy, nocturnal polyuria due to hyperglycemia [5, 7, 14-16]. On the other hand, sleep problems may result in significant hormonal fluctuations, immunologic dysfunction, metabolic alterations and the resulting poor glycemic control may result in higher chances of chronic complications of diabetes [17-19].

Despite the strong proven association between diabetes and sleep related adverse consequences and positive impact of proper management of sleep related disorders [20] in diabetes population, little attention is given to this aspect in clinical care of diabetic population in India. This can be attributed to scarcity of literature documenting the prevalence of sleep disorders in diabetes population and their adverse consequences in India. Studies to fill this vital gap in the knowledge are need of the hour.

Objectives

- To assess the sleep pattern in type II diabetes mellitus patients
- To assess the impact of sleep quality on glycemic control in diabetic patients
- To assesses the factors influencing the sleep quality in patients with type II diabetes mellitus

Materials and methods

The study is a hospital based descriptive cross sectional study, conducted in the department of internal medicine and psychiatry of a tertiary care teaching hospital in Telangana, South India from August 2015 to December 2015.

Patients of type II diabetes mellitus who were attending the outpatient department of psychiatry and internal medicine in the study setting were recruited sequentially in to the study after screening for compliance with inclusion and exclusion criteria. Persons above age 18, of either sex, diagnosed with type II 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.

After obtaining informed written consent, each subject was interviewed using a structured case report form (CRF) to collect information regarding the socio demographic variables like age, gender, education, socio economic and marital status of the individual. Disease related parameters like duration of illness, medication being used and symptoms /signs suggestive of Diabetes related complications were also documented by thorough history and clinical examination. After that 5 ml of venous blood was drawn to check the relevant laboratory parameters like HbA1C, FBS/RBS, blood urea nitrogen (BUN) and creatinine. Each patient was evaluated for micro albuminuria and also for CAD using standard 12 lead ECG. Fundoscopy was carried out to evaluate for diabetic retinopathy.

Sleep pattern was assessed by Pittsburg Sleep Quality Index (PSQI), which is a structured and validated instrument, being used across the globe to assess the sleep quality. Person with total PSQI score of 5 and above was considered as “poor sleeper” [21]. HbA1c level of ≥ 7 was considered as poor glycemic control as per Standards of Medical Care in Diabetes, 2016 guidelines [22].

Approval of the institute Human Ethics committee was obtained. Informed written consent was obtained from all the participants, after explaining the objectives of the study, risks and benefits involved. The personal details of the patients were kept confidential throughout the study.

Sleep pattern as assessed by PSQI global score and glycemic control were the outcome variables and various socio-demographic and disease related parameters were considered as explanatory variables. Descriptive analysis of the data was done by using frequency and percentage for categorical variables, mean and standard deviation for quantitative variables. The association between Glycemic control and sleep pattern was assessed by calculating the odds ratio and 95% CI. Chi square test was used to test the statistical significance of the association. Univariate logistic regression analysis was used to assess the association between various explanatory parameters and sleep pattern, Factors showing significant association were included in the multivariate logistic regression analysis. P value 0.05 was considered as statistically significant. IBM SPSS version 21 was used for statistical analysis.

Results

A total of 100 participants were included in the final analysis. Majority (62%) of the patients were in the age group of 41 to 60 years and females constituted 58% of the study population. Illiterates constituted 35% of study subjects and the proportion of people with primary, high school and diploma and above educational qualification was 20%, 28% and 17% respectively. Majority of the subjects (43%) were unskilled labor. The proportion of subjects hailing from urban area was 70% with 15% of the subjects each from semi urban and rural areas. Married people constituted 85% of the study subjects (**Table - 1**).

The duration of the illness was between 1 to 5 years in 36% of the study population and 24%

and 13% of them had the illness for last 5 to 10 years and more than 10 years respectively. About 27% had the disease for less than 1 year. The proportion of subjects with OHA mono and poly therapy was 36% and 13% respectively. Only insulin was being used in 11% of the subjects and 40% of them were on combined insulin and

OHA therapy. Glycemic control was good in 63% and the remaining 47% had poor glycemic control. Diabetic neuropathy and nephropathy were the most common complications seen in 72% and 48% of the subjects respectively (**Table - 2**).

Table - 1: Baseline characteristics of study population (N=100).

Parameter	Category	Frequency	Percentage
Age group	21 to 40	10	10.0
	41 to 60	62	62.0
	61 and above	28	28.0
Gender	Female	58	58.0
	Male	42	42.0
Education	Illiterate	35	35.0
	Primary	20	20.0
	High school	28	28.0
	Diploma and above	17	17.0
Occupation	Skilled	39	39.0
	Semi-skilled	18	18.0
	Unskilled	43	43.0
Area of residence	Urban	70	70.0
	Rural	15	15.0
	Semi urban	15	15.0
Marital status	Currently Married	85	85.0
	Widow/ widower and divorced	15	15.0

Sleep pattern (PSQI global score ≥ 5) was poor in 64% of the study subjects. The odds of poor glycemic control were 3.56 (95% CI 1.47 to 8.60, p value 0.004) times higher in people with poor sleep quality, compared to people with good sleep quality (**Table - 3**).

Multivariate logistic regression analysis showed higher risk of poor sleep with increasing age, male gender and combined insulin and OHA therapy. But none of these associations were statistically significant. A strong association between diabetic neuropathy and poor sleep pattern was seen in the study, as the odds of poor sleep were 3.5 times higher in people with

diabetic neuropathy (95% CI 1.27 to 9.59, p value 0.05). None of the other socio demographic or disease related parameters have shown statistically significant association with poor sleep pattern (**Table - 4**).

Discussion

The prevalence of poor sleep pattern in the current study (64%) is at the higher end of range of prevalence (42 to 71%) reported by previous studies [3, 4]. This higher prevalence emphasizes the importance of considering evaluation and management of sleep in diabetic patients in India. Also the odds of poor glycemic control were 3.56 times higher in people with poor sleep

quality, compared to people with good sleep quality. Similar to our study, an independent association between sleep deficiency, DM and glycemic control has been reported in many large population based studies [6, 14, 23-26]. Regarding the specifics of sleep disturbances, sleep quality in terms of frequent night

awakenings seems to influence the insulin resistance though, indirectly while the duration of sleep was not associated with it [14]. Considering the impact of good glycemic control in preventing long term complications of diabetes, due emphasis needs to be given to sleep quality to achieve good glycemic control.

Table - 2: Presence of co-morbidities and complications in study population.

Parameter	Category	Frequency	Percentage
Duration of illness	Up to 1 year	27	27.0
	1-5 years	36	36.0
	5-10 years	24	24.0
	More than 10 years	13	13.0
Treatment	OHA mono therapy	36	36.0
	OHA poly therapy	13	13.0
	Insulin	11	11.0
	OHA plus insulin	40	40.0
Glycemic control	Good control	53	53.0
	Poor control	47	47.0
Complications	Neuropathy	72	72.0
	Nephropathy	48	48.0
	Retinopathy	4	4.0
	Diabetic foot	3	3.0
	CAD	1	1.0
Sleep pattern	Poor	64	64.0%
	Good	36	36.0%

Table - 3: Impact of poor sleep pattern on glycemic control.

Sleep pattern	Glycemic control		OR	95% CI of OR		P value
	poor	good		Lower	Higher	
Poor (N=64)	37 (57.8%)	27 (42.2%)	3.56	1.47	8.60	0.004
Good (n=36)	10 (27.8%)	26 (72.2%)				

Chasens, et al. reported in their study that diabetic patients with poor sleep had difficulty in controlling their glucose levels. However, demographic factors such as education, age, gender, were not found to be associated with

diabetes control problems [27]. Though, existing clinical evidence showing restriction in insulin resistance, there is still a doubt as whether the relationship between sleep quality and DM is bidirectional [28, 29].

Table - 4: Multivariate logistic regression analysis of Factors influencing the sleep pattern among diabetic population.

Parameter	Adjusted odds ratio	p-value	95% C.I. of OR	
			Lower	Upper
Age group (Baseline = 21 to 40 years)				
41 to 60	1.962	.443	.350	10.990
61 and above	1.736	.563	.268	11.234
Gender(Baseline = female)				
Male	1.156	.766	.445	3.005
DM neuropathy (Baseline = No neuropathy)				
Presence of neuropathy	3.503	.015	1.279	9.590

Regarding the association between OSA and DM, there are multiple pathways explaining their interaction. One proposed pathway suggests that patients with OSA may have heightened physiological perturbations along with intermittent hypoxemia and increased sympathetic tone [30]. The other mechanism is that sleep deprivation, hypoxia (in OSA) and obesity have independently been associated with pronounced inflammation, oxidative stress, impaired glucose tolerance and insulin resistance [31]. The associations between sleep apnea (risk) and glucose metabolic deregulation may be explained by coexisting diseases that have obesity as a common denominator.

Another interesting finding of the study is that the neuropathy observed among the study population was strongly associated with poor sleep quality. In a study Rosenfeld V [32] has emphasized a strong relation between diabetes, sleep and pain induced by neuropathy. Some of the previous studies have documented a strong association of poor sleep with other complications like nephropathy [15] and retinopathy [33], but the current study has not demonstrated any association with these complications.

Conclusion

To conclude, study findings imply that poor sleep quality increases the risk of poor glycemic

control among diabetics. Hence, greater emphasis is needed to ascertain various sleep disturbances including OSA among diabetics, as they will have far reaching physiological and psychological effects on these patients by impacting their quality of life.

Acknowledgement

We greatly appreciate the help and support provided by our Institute Managing Director, Dr. Md Sarib Rasool Khan in conducting the study.

References

1. Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants. *Lancet* (London, England). 2016.
2. Sridhar GR, Madhu K. Prevalence of sleep disturbances in diabetes mellitus. *Diabetes research and clinical practice*, 1994; 23(3): 183-6.
3. Knutson KL, Ryden AM, Mander BA, Van Cauter E. Role of sleep duration and quality in the risk and severity of type 2 diabetes mellitus. *Archives of internal medicine*, 2006; 166(16): 1768-74.
4. Lopes LA, Lins Cde M, Adeodato VG, Quental DP, de Bruin PF, Montenegro RM, Jr., et al. Restless legs syndrome

- and quality of sleep in type 2 diabetes. *Diabetes care*, 2005; 28(11): 2633-6.
5. Punjabi NM, Shahar E, Redline S, Gottlieb DJ, Givelber R, Resnick HE. Sleep-disordered breathing, glucose intolerance, and insulin resistance: the Sleep Heart Health Study. *American journal of epidemiology*, 2004; 160(6): 521-30.
 6. Lou P, Qin Y, Zhang P, Chen P, Zhang L, Chang G, et al. Association of sleep quality and quality of life in type 2 diabetes mellitus: a cross-sectional study in China. *Diabetes research and clinical practice*, 2015; 107(1): 69-76.
 7. Nefs G, Donga E, van Someren E, Bot M, Speight J, Pouwer F. Subjective sleep impairment in adults with type 1 or type 2 diabetes: Results from Diabetes MILES--The Netherlands. *Diabetes research and clinical practice*, 2015; 109(3): 466-75.
 8. Osonoi Y, Mita T, Osonoi T, Saito M, Tamasawa A, Nakayama S, et al. Poor sleep quality is associated with increased arterial stiffness in Japanese patients with type 2 diabetes mellitus. *BMC endocrine disorders*, 2015; 15: 29.
 9. Surani S, Brito V, Surani A, Ghamande S. Effect of diabetes mellitus on sleep quality. *World journal of diabetes*, 2015; 6(6): 868-73.
 10. Ioja S, Weir ID, Rennert NJ. Relationship between sleep disorders and the risk for developing type 2 diabetes mellitus. *Postgraduate medicine*, 2012; 124(4): 119-29.
 11. Mallon L, Broman JE, Hetta J. High incidence of diabetes in men with sleep complaints or short sleep duration: a 12-year follow-up study of a middle-aged population. *Diabetes care*, 2005; 28(11): 2762-7.
 12. Spiegel K, Tasali E, Leproult R, Van Cauter E. Effects of poor and short sleep on glucose metabolism and obesity risk. *Nature reviews Endocrinology*, 2009; 5(5): 253-61.
 13. Tang Y, Meng L, Li D, Yang M, Zhu Y, Li C, et al. Interaction of sleep quality and sleep duration on glycemic control in patients with type 2 diabetes mellitus. *Chinese medical journal*, 2014; 127(20): 3543-7.
 14. Arora T, Chen MZ, Omar OM, Cooper AR, Andrews RC, Taheri S. An investigation of the associations among sleep duration and quality, body mass index and insulin resistance in newly diagnosed type 2 diabetes mellitus patients. *Therapeutic advances in endocrinology and metabolism*, 2016; 7(1): 3-11.
 15. Edalat-Nejad M, Jafarian N, Yousefichaijan P. Diabetic nephropathy: a strong predictor of sleep quality in hemodialysis patients. *Saudi journal of kidney diseases and transplantation: an official publication of the Saudi Center for Organ Transplantation, Saudi Arabia*, 2014; 25(4): 774-80.
 16. Fontela PC, Winkelmann ER, Pretto LM, Berlezi EM. Sleep respiratory disorders and clinical profile in patients with type 2 diabetes mellitus. *International archives of otorhinolaryngology*, 2015; 19(1): 67-73.
 17. Copinschi G. Metabolic and endocrine effects of sleep deprivation. *Essential psychopharmacology*, 2005; 6(6): 341-7.
 18. Spiegel K, Leproult R, L'Hermite-Baleriaux M, Copinschi G, Penev PD, Van Cauter E. Leptin levels are dependent on sleep duration: relationships with sympathovagal balance, carbohydrate regulation, cortisol, and thyrotropin. *The Journal of clinical endocrinology and metabolism*, 2004; 89(11): 5762-71.
 19. Van Cauter E, Spiegel K, Tasali E, Leproult R. Metabolic consequences of sleep and sleep loss. *Sleep medicine*, 2008; 9 Suppl 1: S23-8.
 20. Khosravan S, Alami A, Golchin Rahni S. Effects of continuous care model based non-pharmacological intervention on

- sleep quality in patients with type 2 diabetes mellitus: a randomized controlled clinical trial. *International journal of community based nursing and midwifery*, 2015; 3(2): 96-104.
21. Buysse DJ, Reynolds CF, 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry research*, 1989; 28(2): 193-213.
 22. Standards of Medical Care in Diabetes-2016 Abridged for Primary Care Providers. *Clinical diabetes* : a publication of the American Diabetes Association, 2016; 34(1): 3-21.
 23. Gottlieb DJ, Punjabi NM, Newman AB, Resnick HE, Redline S, Baldwin CM, et al. Association of sleep time with diabetes mellitus and impaired glucose tolerance. *Archives of internal medicine*, 2005; 165(8): 863-7.
 24. Kent BD, Grote L, Ryan S, Pepin JL, Bonsignore MR, Tkacova R, et al. Diabetes mellitus prevalence and control in sleep-disordered breathing: the European Sleep Apnea Cohort (ESADA) study. *Chest*, 2014; 146(4): 982-90.
 25. Ramos AR, Wallace DM, Pandi-Perumal SR, Williams NJ, Castor C, Sevcik MA, et al. Associations between sleep disturbances and diabetes mellitus among blacks with metabolic syndrome: Results from the Metabolic Syndrome Outcome Study (MetSO). *Annals of medicine*, 2015; 47(3): 233-7.
 26. Yoda K, Inaba M, Hamamoto K, Yoda M, Tsuda A, Mori K, et al. Association between poor glycemic control, impaired sleep quality, and increased arterial thickening in type 2 diabetic patients. *PloS one*, 2015; 10(4): e0122521.
 27. Chasens ER, Korytkowski M, Sereika SM, Burke LE. Effect of poor sleep quality and excessive daytime sleepiness on factors associated with diabetes self-management. *The Diabetes educator*, 2013; 39(1): 74-82.
 28. Spiegel K, Knutson K, Leproult R, Tasali E, Van Cauter E. Sleep loss: a novel risk factor for insulin resistance and Type 2 diabetes. *Journal of applied physiology (Bethesda, Md : 1985)*, 2005; 99(5): 2008-19.
 29. Spiegel K, Leproult R, Van Cauter E. Impact of sleep debt on metabolic and endocrine function. *Lancet (London, England)*, 1999; 354(9188): 1435-9.
 30. Barone MT, Menna-Barreto L. Diabetes and sleep: a complex cause-and-effect relationship. *Diabetes research and clinical practice*, 2011; 91(2): 129-37.
 31. de Mello MT, Narciso FV, Tufik S, Paiva T, Spence DW, Bahammam AS, et al. Sleep disorders as a cause of motor vehicle collisions. *International journal of preventive medicine*, 2013; 4(3): 246-57.
 32. Rosenfeld V. Sleep dysfunction, diabetes, and pain: a troublesome triad. *The Journal of family practice*, 2014; 63(6 Suppl): S18-24.
 33. Ren H, Xu Y, Chang B, Yang J, Zheng M, Yang Y, et al. [Association between retinopathy and sleep disorder in patients with type 2 diabetes mellitus]. *Zhonghua yi xue za zhi*, 2015; 95(32): 2579-83.