Original Article

Plasma Glycated Hemoglobin and Sleep Patterns in Local Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Objective: To ascertain glycemic control and sleep quality in patients with Type 2 Diabetes Mellitus and compare them with age-matched non-diabetic control subjects.

Methodology: In this cross-sectional study, plasma glycated hemoglobin (HbA1c) levels and sleep patterns in diabetic subjects were compared with non-diabetic control subjects. Ethical approval was granted by the institutional ethical review board of Central Park Medical College vide number CPMC/IRB/1728. After taking written informed consent, a total of fifty participants between the ages of 40-60 years were recruited by convenience sampling from the medical outpatient clinic at Central Park Teaching Hospital in 2018. Based on the fasting blood glucose levels, participants were categorized as Group I (diabetic subjects) and Group II (non-diabetic control subjects). Sleep quality was assessed using two validated scales, namely Insomnia Severity Index (ISI) and Epworth Sleepiness Scale (ESS). HbA1c levels were evaluated using standardized blood assays. Independent samples t-test was employed to determine mean differences between the two groups. A p-value of ≤ 0.05 was considered significant.

Results: Mean age of the study participants (n=50) was 49.28±2.34 years. The diabetic subjects had significantly higher HbA1c levels (10.15±2.50 vs. 6.26±1.04; p-value 0.001) and ISI scores (12.64±7.91 vs. 4.68±4.88; p-value 0.000) as compared to non-diabetic control subjects, indicating poorer glycemic control and greater degree of insomnia.

Conclusion: Poorly controlled diabetes mellitus as reflected by higher HbA1c levels is associated with increased insomnia.

KEYWORDS: Diabetes Mellitus, Glycated Hemoglobin, Insomnia, Insulin Resistance

INTRODUCTION

Diabetes Mellitus is a group of indisputably pervasive metabolic irregularities distinguished by hyperglycemia which may either result majorly from lack of insulin production by the pancreas called Type-1 Diabetes Mellitus (TDM1) or a combination of insulin resistance and relative insulin insufficiency called Type II Diabetes Mellitus (TDM2).

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Prevalence of diabetes mellitus in Pakistan has rapidly increased in the last decade. Up to 35.5 million patients were reported in 2017, making Pakistan one of the largest diabetic populations in the world.[1]

Sleep related disorders such as insomnia, narcolepsy and obstructive sleep apnea are more commonly observed in diabetic subjects as compared to non-diabetic subjects.[2,4] The co-existence of such disorders with diabetes has unpropitious effects on glycemic control which further exacerbate the condition.[5,6] Insomnia predisposes not only to diabetes mellitus, but also to hypertension, obesity, stroke and heart attack.[7]Bringing into context the sequelae of insomnia, affected diabetic patients are subjected to higher mortality rates and poorer quality of life. Symptoms of diabetes such as polyphagia, polyuria and polydipsia additionally worsen quality of sleep, forming a vicious circle.[8,9] Thus, evaluation of sleep patterns and its quality in the local diabetic population is crucial in understanding and mitigating of long-term deleterious diabetes.

Glycated Hemoglobin (HbA1c) is form of hemoglobin found normally in the blood whose levels are elevated exclusively in diabetic patients.[10] Body glucose is directly proportional to the amount of HbA1c

present in an individual's blood. The HbA1c test, typically conducted at an average of three months, is a convenient means of diagnosing and evaluating diabetic patients' health. Regular HbA1c testing to monitor glycemic control is imperative for establishing the adequacy of disease management regimen.[11,12] Poor glycemic control in subjects with TDM2 as signified by elevated HbA1c levels may potentially lead to sleep disturbances and vice versa. There remains a need to study the adequacy of glycemic control in the local TDM2 population, particularly in light of its impact on the quality and quantity of sleep. The present study addressed this need by determining HbA1c levels and sleep parameters in patients having TDM2 from the local population and comparing them with age-matched non-diabetic control subjects.

METHODOLOGY

The cross-sectional analytical study was carried out at Central Park Medical College, Lahore from 1st January to 31st December 2018. Ethical approval was obtained from the institutional ethical review board of Central Park Medical College, Lahore vide number CPMC/IRB/1728. A total of fifty individuals, both males and females, between the ages of 40 and 60 years were enrolled in the study after taking written informed consent. The subjects were recruited from the medical outpatient clinic of Central Park Teaching Hospital, Lahore by using convenience sampling technique. Fasting blood glucose analysis was done for all participants using glucometer (Accu Chek Active Glucometer). Study participants were divided into two groups on the bases of fasting blood glucose levels, as cut off points described by American Diabetic Association's criteria for diabetes.[13] Twenty five subjects having fasting blood glucose level of 126 mg/dl or greater on two separate occasions were categorized as Group I (diabetic group).Another 25 non-diabetic individuals with a fasting blood glucose level of less than 100mg/dl were categorized as Group II (control group).Participants with fasting blood glucose between 100mg/dl to 125mg/dl excluded. Relevant demographic data (age, sex) were procured on the predesigned proforma. Plasma HbA1c levels were measured using standardized blood assays. Based on the American Diabetic Association's guidelines, HbA1c of 6.5% or above was considered as poor glycemic control.[13] Afterwards, participants' sleep quality was assessed by employing the Epworth Sleepiness Scale (ESS) and Insomnia Severity Index (ISI). ESS is a self-administered tool comprising eight items. It employs a four-point scale to assess an individual's degree of daytime sleepiness with scores ranging from 0 to 24. Higher scores indicate more daytime sleepiness.[14] ISI is a seven item questionnaire that measures the severity, character and influence of insomnia. It also uses a four-point scale with total scores ranging from 0 to 28.[15] More severe insomnia is indicated by a higher score.

Statistical analysis: Data was analyzed using SPSS version23.The entered data was checked for errors and/or omissions. Mean±SD were given for normally distributed quantitative variables. Frequencies or percentages were demonstrated for categorical variables. Independent sample t-test was applied to observe mean differences. A p-value of ≤0.05 was considered statistically significant.

RESULTS

The mean age of all participants (n=50) was 49.28 ± 2.34 years. Group I, with 15 males and 10 females, had a mean age of 49.04±3.06 years and Group II, with 18 males and 7 females, had a mean age of 49.52±2.07years. Statistically significant differences were observed between the two groups on ISI scores and HbA1c levels while ESS scores did not show any difference (Table 1).

The diabetic subjects had significantly higher mean ISI scores as compared to non-diabetic control subjects (2.64±7.91 versus 4.68±4.88; p-value 0.000) indicating greater degree of sleeplessness (insomnia) in diabetic patients.

Table 1: Group comparisons of ISI, ESS and HbA1c scores (n=50)

Parameter	Group I n=25	Group II n=25	p value
	Mean ± SD	Mean ± SD	
Insomnia Severity Index (ISI)	12.64 ± 7.91	4.68 ± 4.88	0.000*
Epworth Sleepiness Scale (ESS)	4.60 ± 3.34	5.56 ± 3.54	0.407
Serum HbA1c (%)	10.15 ±2.50	6.26 ± 1.04	0.000*

*Difference is significant at p ≤ 0.05, SD =Standard Deviation, HbA1c= Glycated Hemoglobin

Significantly higher mean levels of HbA1c were in diabetic patients. Significantly higher mean levels of HbA1c were observed in diabetic subjects as compared to controls, revealing poorer glycemic control in diabetic patients (10.15±2.50 versus. 6.26±1.04; p-value 0.001). No significant difference in mean ESS scores was observed between the two groups (Group I 4.60±3.34 vs Group II 5.56 ± 3.54; p=0.407).

DISCUSSION

The present study explored the relationship between glycemic control and sleep in patients with TDM2. Comparisons were made with non-diabetic control subjects. Significantly higher HbA1c levels were observed in diabetics when compared with non-diabetic subjects, that is in accordance with several previous studies which additionally links elevated glycated hemoglobin with higher risk of co-morbidities, more complications and high mortality rate.[12]Significantly higher degree of sleeplessness was observed in diabetic patients which are consistent with findings from a previous study conducted on Chinese population showing that higher HbA1c level is associated with the sleeplessness and poor sleep quality.[6] The present findings are also in line with results from a recent study in which Japanese patients with TDM2 with inadequate glycemic control were shown to have poor subjective sleep quality.[16]

Diabetic subjects are more prone to the development of sleep disorders which are particularly associated with poor glycemic control.[2,3] Inadequate glycemic control has been shown to be associated with sleep apnea.[5] Elevated blood glucose levels are believed to disrupt normal sleep mechanisms which predispose the affected individuals to the sleep disturbances.[6] Ineffective management of diabetes mellitus has been linked to poor sleep, possibly due to physical and psychological discomforts associated with the disease.[10] Day time sleepiness caused by night-time sleeplessness in diabetic individuals has been shown to aggravate depressive symptoms and may further lead to alteration in glucose metabolism.[17] Surani et al. showed that poor glycemic control leads to imbalance that alter sleep physiology, leading to insomnia in diabetic patients.[4] Sleep apnea and other sleep disorders are highly associated with obesity, which itself is a common trait of patients who develop TDM2 owing to the insulin resistance seen in obese individuals. Regular circadian rhythms are essential for effective insulin production and utilization. Sleep disturbances in diabetic subjects have also been shown to cause impairment in glucose metabolism as a result of inappropriate production and/or action of insulin.[8] In a recent study on diabetic population with poor sleep quality, high levels of fasting c-peptide and insulin were observed which are all reflective of poor glycemic control. Poor sleep quality was also linked with increased risk of diabetic polyneuropathy.[18] This study is limited by the relatively small sample size and consequently, by the limited analysis which do not account for possible confounding factors such as gender, weight, relatively wide age range and other co-morbid conditions which may influence sleep. The present study only employed questionnaires which shed light on the quantitative aspect of sleep. Sleep quality is comprehensive entity which, in addition to subjective questionnaires, requires measurement using objective means such as electroencephalography and autography. Furthermore, factors like day-to-day stresses, sleeping habits and working hours have impact on both sleep quantity as well as on quality which is also need to be considered. Definitive results could be obtained with carefully designed future studies with higher sample size.

CONCLUSION

Poorly controlled type 2 diabetes mellitus, as reflected by higher HbA1c levels, is associated with increased insomnia. Adequate glycemic control may improve sleep quality in diabetic patients.

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Conflicts of Interest: None.

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Dr. Asim Mumtaz	Conception and design of the study, drafting, review, revision and finalization of this manuscript.
Dr. Syed Imran Ali Shah:	Responsible for conception and design of the study, as well as drafting, review, revision and finalization of this manuscript.
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