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ORIGINAL ARTICLE

Physio Biochemical Aspects of Sleeping Patterns in Relation to Plasma Glycated Haemoglobin Level in Type 2 Diabetic Patients

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ABSTRACT

Introduction: Diabetes mellitus is a persistent metabolic condition distinguished by raised levels of glucose in the bloodstream, commonly referred to as hyperglycemia. This phenomenon arises due to insufficient endogenous insulin production or impaired insulin utilization by the body. Insulin is a hormone that is biosynthesized and secreted by the pancreatic gland, functioning to modulate the concentration of blood glucose in the body. Glycated hemoglobin, typically referred to as hemoglobin A1c or HbA1c, is a variant of hemoglobin that undergoes glycation upon prolonged exposure to elevated levels of glucose within the bloodstream. Hemoglobin is a crucial protein that is present within erythrocytes and is primarily responsible for the transportation of oxygen across the various tissues of the body. The assessment of HbA1c serves as a means of determining an individual's mean blood glucose levels during the preceding two to three months. The monitoring of long-term glycemic control in individuals with diabetes mellitus is widely recognized to be of utmost importance, with a valuable marker for this purpose being deemed necessary. The levels of HbA1c are commonly reported as a proportion of the total hemoglobin within the circulating blood in the form of a percentage.

Objective: To compare the effects of sleeping patterns and plasma glycated haemoglobin levels in type 2 diabetic and non diabetic patients

Study Design: Quantitative cross sectional

Settings: Punjab Rangers Teaching Hospital, Lahore

Duration: Four months i.e. 1st August 2022 to 31st December 2022

Data Collection Procedure: A pre validated questionnaire was used. Study was carried out at Punjab Rangers Teaching Hospital, Lahore. The total numbers of faculty members were 70 who participated after taking the informed consent. The study was done by simple random sampling technique. A fasting blood glucose analysis was conducted on all subjects through the collection of a 5cc blood sample. The study enrolled participants who were divided into two distinct groups based on their fasting blood glucose levels in which 35 were diabetic and 35 were controlled. Mean & standard deviation was calculated. P value is <0.005 means significant.

Results: There were 70 participants in the study which equally divided into two groups i.e. thirty five each namely diabetic and controlled one. The participants in diabetic group include 18 males and 17 females while in control group 22 males and 13 females. After analyzing the data we came to know the statistical significant results were shown by insomnia severity index and HbA1c parameters as indicating major difference when compared both controlled and diabetic group in each parameter. Epworth sleepiness scale did not show any significant difference.

Conclusion: It is concluded in this study that patients with poor diabetic control have less diabetic HbA1c control which increase higher levels of insomnia which clearly noted in the diabetic group when compared to control one. If we control the glycemic control of patients then definitely the level of insomnia decreases by providing the sleep comfort in daily life.

Keywords: Diabetes mellitus, glycated haemoglobin, sleeping patterns, Type 2 diabetes, Insulin

INTRODUCTION

Diabetes mellitus is a persistent metabolic condition distinguished by raised levels of glucose in the bloodstream, commonly referred to as hyperglycemia. This phenomenon arises due to insufficient endogenous insulin production or impaired insulin utilization by the body. Insulin is a hormone that is biosynthesized and secreted by the pancreatic gland, functioning to modulate the concentration of blood glucose in the body(1).

There are numerous variations of diabetes mellitus, among which the prevailing types include:

Type 1 diabetes mellitus commonly presents during childhood or early adulthood as an autoimmune disorder characterized by the aberrant targeting and annihilation of pancreatic β-cells responsible for insulin secretion by the body's immune system. Individuals diagnosed with type 1 diabetes require regular administration of exogenous insulin via injection or an insulin pump to effectively regulate their blood glucose levels(2).

Type 2 diabetes is the prevalent manifestation of diabetes which typically arises in adulthood, though it can manifest at any stage of life. Type 2 diabetes is characterized by either an insufficient production of insulin or a reduced sensitivity to its effects, which leads to the inability to regulate blood glucose levels within normal ranges. The phenomenon is frequently correlated with modifiable lifestyle elements such as excessive adiposity, sedentary behavior, and suboptimal nutritional patterns. Type 2diabetes is known to be occasionally controllable through the use of lifestyle changes, pharmaceutical interventions utilizing oral medications, or the administration of insulin therapy(2).

Gestational diabetes is a form of diabetes that manifests in pregnant women with previously normal blood glucose levels, resulting in elevated blood sugar levels. The manifestation of gestational diabetes commonly abates following delivery; however, females with a history of gestational diabetes are prone to an elevated likelihood of acquiring type 2 diabetes in the future.

Glycated hemoglobin, typically referred to as hemoglobin A1c or HbA1c, is a variant of hemoglobin that undergoes glycation upon prolonged exposure to elevated levels of glucose within the bloodstream. Hemoglobin is a crucial protein that is present within erythrocytes and is primarily responsible for the transportation of oxygen across the various tissues of the body.

The assessment of HbA1c serves as a means of determining an individual's mean blood glucose levels during the preceding two to three months. The monitoring of long-term glycemic control in individuals with diabetes mellitus is widely recognized to be of utmost importance, with a valuable marker for this purpose being deemed necessary. The levels of HbA1c are commonly reported as a proportion of the total hemoglobin within the circulating blood in the form of a percentage(2, 3).

In individuals free from diabetes, the levels of HbA1c generally fall within the range of 4% to 5. 6% Elevated levels of HbA1c in individuals with diabetes are indicative of inadequate glycemic control and heightened susceptibility to complications associated with diabetes. The optimal HbA1c level for the majority of individuals with diabetes is generally considered to be less than 7%; however, customized targets may differ according to variables such as age, duration of diabetes, and co-morbidities[4, 5].

It is crucial to acknowledge that glycated hemoglobin (HbA1c) levels solely represent one facet of managing diabetes. In conjunction with HbA1c monitoring, other elements such as effective blood glucose tracking, appropriate dietary and physical activity habits, and strict medication adherence are significant contributors towards achieving optimal glycemic control. Healthcare practitioners employ the utilization of HbA1c in conjunction with other diagnostic indices to tailor specific treatment regimens for individuals afflicted with diabetes[3, 6].

MATERIAL AND METHODS

A pre validated questionnaire was used. Study was carried out at Punjab Rangers Teaching Hospital, Lahore. The total numbers of faculty members were 70 who participated after taking the informed consent. The study was done by simple random sampling technique. A fasting blood glucose analysis was conducted on all subjects through the collection of a 5cc blood sample. The study enrolled participants who were divided into two distinct groups based on their fasting blood glucose levels, utilizing the established diagnostic cut-off values specified by the American Diabetic Association's diagnostic criteria for diabetes. Group I consisted of thirty-five subjects with fasting blood glucose level of 126 mg/dL or higher on two separate occasions, and were categorized as diabetic. Conversely, Group II was comprised of thirty-five non-diabetic individuals with a fasting blood glucose level below 100 mg/dL, and was categorized as controls. Participants with fasting blood glucose levels ranging from 100 mg/dL to 125 mg/dL were excluded from the study. The age of the participants is in between 30-50 years.

Standardized blood assays were utilized to measure plasma levels of HbA1c. According to the guidelines established by the American Diabetic Association, HbA1c level equal to or exceeding 6.5% signifies suboptimal glycemic control. Subsequently, the participants underwent an evaluation of their sleep quality through the implementation of the Epworth Sleepiness Scale (ESS) and Insomnia Severity Index (ISI). The ESS, which is an abbreviation of Epworth Sleepiness Scale, is a self-administered instrument consisting of eight items. Increased scores are indicative of heightened levels of daytime somnolence. The Insomnia Severity Index (ISI) is a tool consisting of seven items designed to assess the extent, nature and impact of insomnia. The scale employed in the assessment of insomnia severity employs a four-point grading system, which yields a cumulative score within the range of 0 to 28. A greater severity of insomnia is posited to correspond with a higher score. The data was analyzed using SPSS version 23. Mean & standard deviation was calculated. P value is <0.005 means significant.

RESULTS

There were 70 participants in the study which equally divided into two groups i.e. thirty five each namely diabetic and controlled one. The participants in diabetic group include 18 males and 17 females while in control group 22 males and 13 females. After analyzing the data we came to know the statistical significant results were shown by insomnia severity index and HbA1c parameters as indicating major difference when compared both controlled and diabetic group in each parameter. Epworth sleepiness scale did not show any significant difference. Insomnia severity index (ISI) showing marked difference as higher values in diabetic group i.e. 10.80 + 8.2 when compared to control one 4.80 + 4.65 indicating higher level of insomnia in diabetic ones. The p value is also significant 0.000*. In other parameter of HbA1c showed high level which means poor diabetic control in diabetic group as compared to control one. However Epworth sleepiness scale did not show any significant difference.

Table 1: Demographic Profile N=70

No.	Variable	Group 1 Diabetic group N=35	Group 2 Controlled group N=35
1	Gender		
	Male	18	22
	Female	17	13

Table 2: Comparison of ISI, EPS, HbA1c scores n=70

No.	Variable	Group 1 Diabetic N=35	Group 2 Control N=35	P value
		Mean + SD	Mean + SD	
1	Insomnia severity Index (ISI)	10.80 + 8.2	4.80 + 4.65	0.000*
2	Epworth Sleepiness scale (EPS)	4.90 + 3.56	5.40 + 3.80	0.395
3	HbA1c	10.85 + 3.45	6.30 + 1.20	0.000*

DISCUSSIONS

The current study endeavors to investigate the correlation between glycemic controls and sleep patterns among individuals diagnosed with Type 2 Diabetes Mellitus (TDM2). Statistical comparisons were conducted with a sample of non-diabetic participants serving as controls. The present study revealed a notable increase in HbA1c levels among individuals diagnosed with diabetes in comparison to non-diabetic subjects. This observation aligns with previous literature, which has established the association between elevated glycated hemoglobin and increased susceptibility to co-morbidities, complications, and mortality. Additionally, we noted a marked prevalence of sleep disturbances among diabetic patients, which concurs with a prior investigation conducted on the Chinese population showcasing the correlation between higher levels of HbA1c and sleeplessness, as well as poor sleep quality. The current findings are consistent with the outcomes of a recent investigation in which patients from China, Japan who were diagnosed with TDM2 and had suboptimal glycemic control exhibited unfavorable subjective sleep quality[5, 7].

This study showed that increased levels of blood glucose may disrupt typical sleep processes and incline those who are affected to experience disturbances in their sleep patterns. Poorly managed diabetes mellitus has been linked to suboptimal sleep quality, potentially attributable to the physiological and psychological discomforts associated with the condition. The present research indicates that diabetic individuals who experience nocturnal sleep deprivation may encounter diurnal sleepiness, exacerbating depressive manifestations, and potentially interfering with glucose metabolism. Surani et. al showed that suboptimal glycemic control elicits alterations in the physiological state of sleep, consequently resulting in the manifestation of insomnia among individuals diagnosed with diabetes[8, 9]. The incidence of sleep apnea and other sleep disorders is strongly linked with obesity, a prevalent characteristic among patients who develop type 2 diabetes mellitus (TDM2) due to the insulin resistance commonly found in this population. Maintaining regular circadian rhythms is crucial for the optimal production and utilization of insulin. Sleep disruptions among individuals with diabetes have been demonstrated to impede glucose metabolism through the inappropriate production and/or functioning of insulin. A study conducted on a population with diabetes and inadequate sleep quality revealed elevated levels of fasting c-peptide and insulin, which are both indicative of suboptimal glycemic regulation[10, 11].

CONCLUSION

It is concluded in this study that patients with poor diabetic control have less diabetic HbA1c control which increase higher levels of insomnia which clearly noted in the diabetic group when compared

to control one. If we control the glycemic control of patients then definitely the level of insomnia decreases by providing the sleep comfort in daily life.

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