

Correlation between Haemoglobin and Glycosylated Hemoglobin Level among Type-2 Diabetes Mellitus Patients

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ABSTRACT

Objective: To determine the correlation between hemoglobin and glycosylated hemoglobin level among patients with type 2 diabetes mellitus.

Study Design: Cross Sectional Study.

Place and Duration of Study: Department of Chemical, Combined Military Hospital, Multan Pakistan, from Jul to Dec 2019.

Subject and method: After approval from ethical community and written informed consent from the patient, sample were obtained under strict aseptic technique and were immediately sent to hospital laboratory to detect glycosylated hemoglobin level.

Result: One hundred and ninety-five (195) patients were studied out of which (161) were female gender and (34) were male gender. The correlation between hemoglobin and glycosylated hemoglobin level through Pearson correlation coefficient shows a very low negative correlation of -0.253 which is statistically significant with p -value <0.001 .

Conclusion; Correlation of hemoglobin and glycosylated hemoglobin level thus may prove to be useful and consistent predictive indicator in patients with type-2 diabetes mellitus.

Keywords: Diabetes mellitus frequency, Glycosylated hemoglobin, Hemoglobin.

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INTRODUCTION

According to an International Diabetic Federation report which was published in 2015, narrated that four hundred and fifteen million people all over the world are diagnosed with diabetes mellitus and the report further assumed that it could reach to six hundred and forty two million people by 2040.¹ Furthermore, one out of every two patients remains from diagnosis and this fatal disease had claimed the lives of five million people in the year 2015. This showed that at every sixth second, a patient of diabetes mellitus die due to its complications.²

The diabetes mellitus caused due to multi facatorial reasons behind it varying from virus to autoimmune as well as genetic defect and insulin secretory/resistance defect. The prevalence of type-2 diabetes is common in community as compared to type-1. The raised glycated hemoglobin and blood glucose levels always lead to the complication of the diabetes mellitus over to the duration of the disease.³

Glycated hemoglobin is a fraction of hemoglobin A1c (HbA1c), it is taken as parameter to find out the

average concentration of glucose for a period of two to three months over the relatively long duration of time.⁴ As glycated Hemoglobin can be tested any time without a special case and effected less by acute perturbations i.e. fasting of the patient is not required, which helps in more precise and accurate result.⁵

It is suggested that glycated hemoglobin play a vital role for the indication of the glucose control as compared to fasting plasma glucose in patients with diabetes. It was studied earlier that glycated hemoglobin is affected by the level of glucose in the blood only.⁶ Along with it, other studies have shown that glycated hemoglobin levels are changed by different co existing factors, along with diabetes mellitus i.e. iron deficiency anemia and haemoglobinopathies, earlier is a big problem in the developing countries regarding public health. According to some other research work it has shown the relationship of total haemoglobin and glycated haemoglobin in anemic patients, the value of Hb1c which got decreased after taking iron.⁷

Hemoglobin is a vital erythrocyte protein, any structural change in it will result in disturbance of functionality in the cells associated with other factors like temperature alteration, environmental changes, chemical modification and pH deviations.⁸ Moreover,

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hemoglobin aggregation in erythrocytes which is caused by oxidative stress in patients with diabetes further leading to the complications of diabetes and its progression.⁹

In patients with diabetes with coexisting anemia, HbA1c levels may be falsely high, so in these conditions use of HbA1c for the diagnosis and monitoring of diabetes is debatable.¹⁰ The present study is designed to explore this pitfall in the use of HbA1c for monitoring of anemic patients with type-2 diabetes. We will determine the correlation between hemoglobin levels and glycated hemoglobin in our local diabetic population as no such study has been done locally. This study will provide us not only local statistics about correlation between hemoglobin and glycated hemoglobin but also will give awareness to the clinicians, to treat anemia in patients with diabetes concurrently.

METHODOLOGY

The cross sectional study was carried out after the approval of Ethical Review Board, from June 2019 to January 2020 at the department of Medicine and Pathology Department, Combined Military Hospital Multan. Study sample size was 195, using correlation co-efficient of +0.2027, between HbA1C and haemoglobin, with 95% confidence interval and 80% power of test. Consecutive Non-probability sampling technique was used.

Inclusion Criteria: Patients with at least two-years history of DM and on antidiabetic medications of both genders between 30-65 years of age were included in this study.

Exclusion Criteria: Patients with history of using iron supplements and patients with history of hypertension, coronary or cerebrovascular events and cyanotic congenital heart diseases were excluded because these conditions act as confounders and if included, tends to induce bias in the results.

Three cc of whole blood was drawn from antecubital venipuncture under aseptic technique and collected into tubes containing dipotassium EDTA. The collected specimen of blood was immediately sent to hospital laboratory for haemoglobin measurement as part of full blood count on a Sysmex auto-analyzer. HbA1C was measured from the same blood sample, in the clinical chemistry laboratory using Cobas 501. Results were recorded in the specified Performa along with other demographic variables. The gathered data was analysed by SPSS, version 21. The percentage or frequency were calculated for qualitative variable i.e

age, gender, duration of the disease. Haemoglobin and glycated hemoglobin were counted and calculated. Kolmogorove Smirnov test was applied to check data presentation. Chi square test applied to see association between hemoglobin and glycosylated hemoglobin, between hemoglobin and age, between glycosylated hemoglobin and age, between hemoglobin and gender. To check the relationship between glycated hemoglobin and hemoglobin, the correlation coefficient of Pearson was applied.

RESULT

A total of 195 patients with Type-2 diabetes mellitus were included in this study. Out of 195 patients 153(78.3%) were females and 42(21.5%) were males. Mean age of the patients was 55.05±10.39 years with age range of 15-77 years. Patient’s ages were divided in three categories. There were 6(3.1%) patients of the age >40 years. 123(63.1%) patients were in the age range of 40-60 years, 66(33.8%) were of age >60 years. The relationship between hemoglobin and glycated haemoglobin level was evaluated through Spearman’s correlation. (as shown in Table-II)

Table-I: Clinico-demographic variables (n=195)

Variables	Mean±SD	Median (IQR)
Age(Years)	55.05±10.39	-
Hemoglobin(g/dl)	-	10.9(11.7-10.1)
Glycosylated Hemoglobin (%)	-	9.8(10.7-8.8)

Table-II: Spearman Correlation between Hemoglobin and Glycosylated Hemoglobin (n=195)

Variables	Spearman Correlation	Values
Age	r value	0.138
	p-value	0.05
Gender	r-value	-0.112
	p-value	0.118
Hemoglobin	r-value	-0.209
	p-value	0.003
Glycosylated Hemoglobin	r-value	-0.209
	p-value	0.003

Spearman’s correlation between hemoglobin and glycosylated hemoglobin, between age and glycosylated hemoglobin, between age and hemoglobin, between gender and hemoglobin and between gender and glycosylated hemoglobin are shown in Table-III, which indicating r-value and p-value.

Gender wise correlation between hemoglobin and glycated hemoglobin level showed that there was effect over gender also. It was revealed that in male population, it was significantly negative correlation coefficient with r-value=-0.133 while in female population, it was low positive correlation coefficient with

p -value=-0.049. Age wise distribution is also very significant with all age groups of this study with p -value <0.05.

Stratification over duration of diabetes shows same pattern with no significance. Stratification over body mass index shows positive low correlation in BMI of <25kg/m² while >25kg/m² shows a low negative correlation with p -value=0.162 & 0.067 respectively.

Table-III: Body Mass Index Wise Distribution of correlation between Glucose and Glycated Hemoglobin (n=195)

Body Mass Index(Kg/m ²)	r-value	p-value
<25	-0.151	0.162
>25	-0.177	0.067

DISCUSSION

Diabetes Mellitus is a disorder of the metabolism, which result due to the defect in the secretion of insulin and its action and is characterized by hyperglycemia. Diabetes Mellitus and its complications lead to poor life quality and disability. It is approximately 5.1 million people die due to diabetes are of age between 20 and 79 years. It is almost 80% of all the morality globally. The expected number of cases in India by 2035 can rise to 109 million which is now 65.1 million.¹¹

The present study shows the predominance of anemia among the women compared to men. Similar results were seen in another study by Sinha *et al.*¹² who also observed IDA to be more prominent among the females rather than males. Christy *et al.* and Chodeshwari *et al.*¹³ also reported similar results in their studies.

Like previous studies, our study also reported a positive correlation between HbA1c and hemoglobin concentration in patients with iron deficiency anemia and, therefore, HbA1c could be a poor indicator in anemic subjects. Koga *et al.*¹⁴ also suggested to monitor while diagnosis in patients with low or high concentration of Hemoglobin at HbA1c level close to 5.7% or 6.5%, respectively.

According to the study, which was carried out by "Brooks *et al.* they conducted an experimental test of HbA1c of 35 non patients with diabetes who were anemic i.e. iron deficiency. Their tests were done both after and before treatment. They have observed the higher levels of HbA1c and the level decreased after the treatment with iron. The same results were found in the study of Cobon *et al.*¹⁵ Tarim *et al.*¹⁶ and Gram-Hansen *et al.*¹⁷

According to the research which was carried out by Raj and Rajan,¹⁸ Iron (Fe) showed direct proportion

in correlation with glycated Hemoglobin, in the patients of diabetes. Canturk *et al.* opined that "Ferritin" Serum level was high until and unless glycemic status was not gotten. They reported the level of ferritin normal in the patients of diabetes but according to Shariti and Sazandeh,¹⁹ they did not come across any important correlation between HbA1c and ferritin in the population of diabetes. They were not able to figure out the shortage of correlation of HbA1C with serum ferritin. Hence our study focused on the importance of correlation between Hemoglobin and glycated Haemoglobin.²⁰

Erythrocyte's main component is Haemoglobin. This is the reason when HbA1C is at high level which could increase in hyperglycemia and which further multiplies the B-sheet structural content of Haemoglobin. Which cause in viscosity of it. When the solubility level of Hamoglobin is decreased results in the increase in the cells the level of viscosity. Which adversely affect the patient of diabetes type-3 and may lead to the complication by causing it difficult to flow via capillaries of the patient.

Besides it the alteration in the structure of HB might lower the peroxidation activity.²¹ Which leads to vascular complications with a four glycemic control the secondary structure of Haemoglobin in the diabetic patient was not changed but it is a fact that the changes occur in HbA1C higher level by 9.0%.²²

Hence we can assume that the high level of HbA1c can be a factor which results in Haemoglobin modification in structure of Hemoglobin of diabetes patients. It can also lead to the pathological complication of diabetes type-2. It is a limited study and more researchers are required to support and show demonstrations to our findings.

CONCLUSION

Our results showed that glycated hemoglobin level is correlated with hemoglobin level. In diabetes mellitus patients the concentration of HbA1C and the status of iron (Fe) must be interpreted. The replacement of iron (Fe) therapy is of vital importance in the iron deficiency patients of diabetes. This would be helpful in increasing the reliability determination of "HbA1C". Proper treatment of hemoglobin deficiency can thus help in improving the diabetic status of the patient.

Conflict of interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

AK & WH: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

MY & AI: Data acquisition, data analysis, approval of the final version to be published.

OA & SU: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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