Original article

Assessment of Contribution of Fasting and Post Meal plasma Glucose to increased Glycated Hemoglobin in Diabetes Mellitus ----A Comparative Study

*Dr. S.W. Masram[a], Dr. M.V. Bimanpalli[b]

*[a]Assistant Professor, Chirayu Medical College & Hospital, Bhopal.
[b]Professor & Head, Govt. Medical College, Nanded.

ARTICLE INFO

Keywords:
Diabetes mellitus
Glycated hemoglobin
Fasting plasma glucose
Post meal plasma glucose

ABSTRACT

Background: Pattern of Glycemic control is found to be different in type-1 & type-2 diabetes mellitus(DM). Hyperglycemia and its correlation with glycated hemoglobin in both types of diabetes mellitus have been well studied and informative to the diagnostic, therapeutic & prognostic aspects of diabetes mellitus. Aim: To interpret & establish the correlation of glycated hemoglobin (GHb or HbA1c) with both fasting plasma glucose (FPG) and post meal plasma glucose (PMPG) in type-1& type-2 DM. Material and Methods: Fifty each already diagnosed patients of type-1 and type-2 diabetes mellitus along with fifty control were studied for glycated hemoglobin and plasma sugar status. Statistical analysis: We have used student t-test and Pearson's correlation coefficient to find the statistical significance. Result: Fasting as well as post meal plasma glucose and serum percentage of glycated hemoglobin were increases simultaneously in both the types of DM as compared to that of control but hike was seen in the Type-2 Diabetes Mellitus. PMPG is high significantly & positively correlated with glycated hemoglobin (P<0.001) in all the three groups of study. Conclusion: Prominent Hyperglycemia & poorer glycemic control are seen in the type-2 DM than those in type-1 DM. Our study revealed that PMPG is appreciably contributes to the glycated hemoglobin rather than FPG in both type-1 & type-2 diabetes mellitus.

1.Introduction:

Incidence of D.M. has been gradually & constantly increasing in urban as well as rural areas in India & it will be one of the major cause of death in India in 21st century. In normoglycemic subjects a carbohydrate moiety is attached to a small proportion of hemoglobin A forming glycated hemoglobin. In conditions of sustained hyperglycemia, such as in diabetes mellitus, the percentage of hemoglobin that is glycated is increased substantially [1]. Various large, randomized clinical trials have been demonstrated that intensive glycemic control prevents the development and progression of long term diabetic microvascular

Excess circulating glucose in diabetes is a reactant molecule that is involved in the glycosylated atom of other biomolecules and complications [2].

tissues. Glycosylation of haemoglobin is particularly popular and of great clinical importance. Glycated haemoglobin (HbA1) expressed as a percentage of total blood haemoglobin concentration gives a retrospective assessment of the mean plasma glucose concentrating during the preceding 6 – 8 weeks. Its measurement is therefore discussed as good method of assessing glycemic control [3] .

There are, however, insufficient data to determine reliably the relative contribution of fasting and postprandial plasma glucose to increases the percentage of glycated hemoglobin (HbA1c). It is very desirable to know whether post meal or fasting plasma glucose, alone or in combination, will be necessary in adjusting the therapy to achieve optimal HbA1c levels[4].

In Diabetes Mellitus (DM) increased percentages of glycated hemoglobin is frequently associated with dyslipidemia . Patient with type 1 DM are generally not hyperlipidemic if they are under good glycemic control. But patient with type-2 DM are usually dyslipidmic even if under relative good glycemic control. Increased

* Corresponding Author : Dr. Shrikant W. Masram,
28, Shriramwadi Premnagar,
Near Itwari railway station,
NAGPUR-440002.
Cell No. 09826919186

percentage of GHb is a risk factor for dyslipidemia which leads to coronary artery disease, a leading cause of mortality in patients with diabetes mellitus[5].

The higher the percentage of circulating HbA1c in the diabetes, the poorer the mean glycemic control. So frequent glycated hemoglobin & plasma glucose assessments are become necessary in both type-1 & type–2 diabetics to monitor complications & prognosis of disease [3]. So we have studied the glycated hemoglobin percentages along with fasting & post meal plasma glucose in type-1 & type-2 diabetics. All these parameters were compared with 50-50 patients each of the Type-1 and type-2 Diabetes mellitus and controls.

2.Materials and Methods:

Fifty Patients with type-1 DM and fifty patients with type-2 D.M. along with fifty control were studied for following parameters :-

1.Plasma Glucose by GOD-POD method.[6]

2.Glycated hemoglobin (GHb) by cation- exchange resin method.[7,8]

Patients were already diagnosed as diabetics and under treatment in diabetic clinic of Indira Gandhi Govt. Medical College and hospital Nagpur.

Equipment & Facility :

Glycated hemoglobin were estimated with the help of reagent kit of cation exchange resin method, supplied by monozyme's glycohemin , Monozyme India limited , Secunderabad. In this method hemolysate were prepared by mixing venous blood with lysing reagent. Labile Schiff bases were eliminated during hemolysis. The hemolysate were then mixed with a weakly binding cation exchange resin. The non-glycosylated hemoglobin bounds to the resin leaving GHb free in the supernatant. The GHb percentages were determined by measuring the absorbance of GHb fraction and the total Hb at 415nm in semiautoanalyser.

Fasting and post meal plasma glucose were estimated by Glucose oxidase & peroxidase enzymatic method using plasma as a sample.

Statistics:

We calculated arithmetic mean, standard deviation (S.D.), standard error of mean and Pearson's correlation coefficient (r) from obtained values. Level of statistical significance was calculated by applying students 't' test.

P value <0.05 was to be considered statistically significant.

3. Results:

Table No.1. Fasting and post meal plasma glucose levels and GHb% in controls and cases

Parameter	Controls n=50		Type-1DM n=50		Type-2DM n=50	
	Range	Mean± SD	Range	Mean± SD	Range	Mean± SD
Fasting Plasma Glucose (mg/dl)	68-110	88.29±10.78	114.3-267.5	169.47±35.51	85-284.1	223.82±37.59
Post meal Plasma Glucose (mg/dl)	120-152	136.14±8.85	160-322	243.93±46.16	168-336.4	269.94±32.71
GHb%	3.9-7.4	5.20±0.94	5.9-13.8	9.10± 1.65	7-14.6	11.06±1.84

Above table shows level of fasting and post meal plasma glucose and glycated hemoglobin in terms of Mean±SD in controls and cases. Table shows both higher values as well as higher ranges of Fasting blood sugar, Post meal blood sugar and glycated hemoglobin in cases as compared to controls.

Bar diagram showing mean levels of different parameters in Control group, Type 1 & Type 2 diabetics.
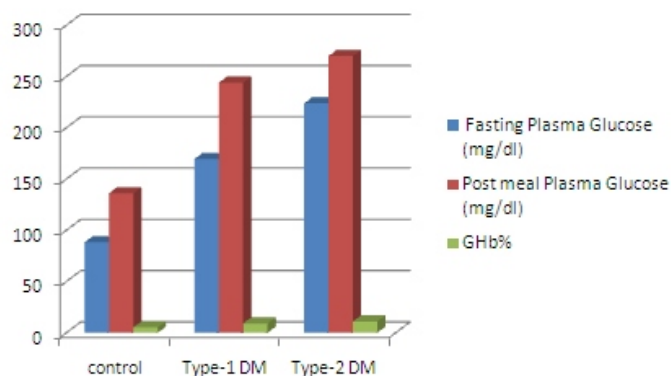

Table No:2 Comparison of level of GHb% between Type-1DM and Type-2DM

Parameter (mg/dl)	Type-1DM n=50 Mean± SD	Type-2DM n=50 Mean± SD	p-value
GHb%	9.10±1.65	11.06±1.84	<0.001

Table shows highly significant increased GHb% (P<0.001) in Type -2DM as compared to that in Type-1 DM.
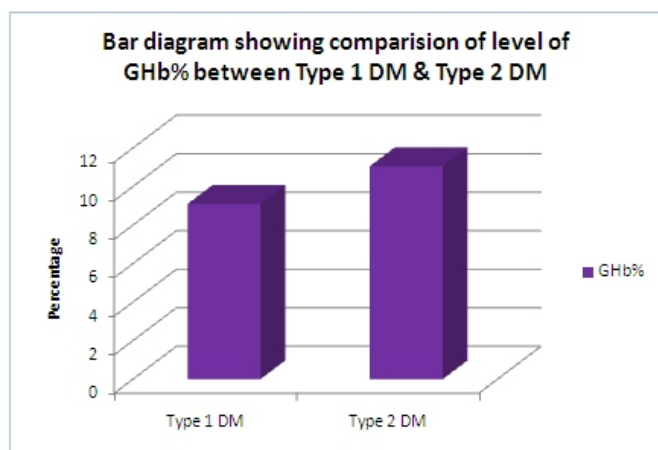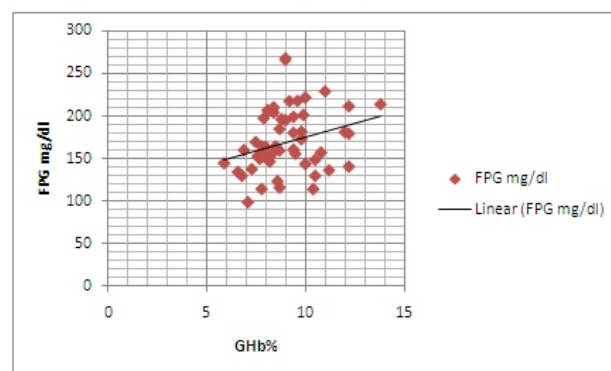

Table No.3   Correlation of Fasting plasma glucose and GHb%

Groups	Fasting plasma glucose(FPG) in mg/dl Mean±SD	Ghb% Mean±SD	Correlation of Coefficient
Controls	88.29±10.78	5.20±0.94	r=+0.733
Type-1 DM	169.47±35.51	9.10±1.65	r=+0.302
Type-2 DM	223.82±37.59	11.06±1.84	r=+0.588

Table shows significant positive correlation between FBS & GHb% in all the three groups of study. The Pearson's correlation coefficient is highly significant (P<0.001) in controls and Type-2 diabetics & significant   (P< 0.05) in Type-1 diabetics.

·Graph showing Correlation between FPG & GHb in Type-1DM:

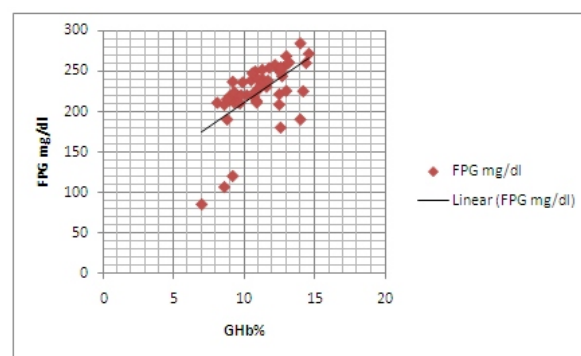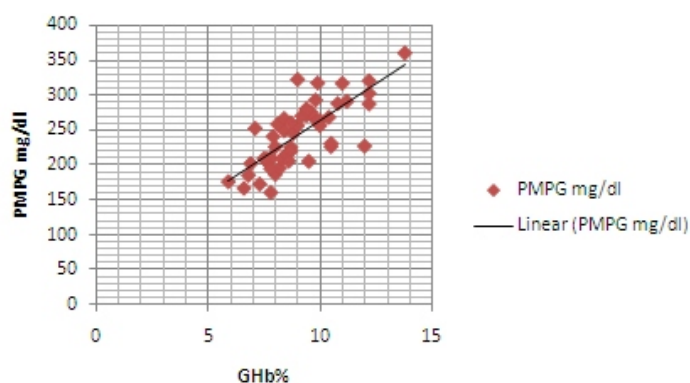**·Graph showing Correlation between FPG & GHb in Type-2 DM:**

**Table No.4 Correlation of Post meal plasma glucose and GHb**

Groups	Post meal (PMPG) in mg/dl Mean±SD	Ghb% Mean±SD	Correlation of Coefficient
Controls	136.14±8.85	5.20±0.94	r= +0.699
Type-1 DM	243.93±46.16	9.10±1.65	r= +0.753
Type-2 DM	269.94±32.71	11.06±1.84	r= +0.776

Table shows highly significant positive correlation between PMBS and GHb% in all the three groups of study. The Pearson's Correlation Coefficient is highly significant (P<0.001) in all the three groups.

· **Graph showing Correlation between PMPG & GHb in Type-1DM:**

· **Graph showing correlation between PMPG & GHb in Type-2 DM:**
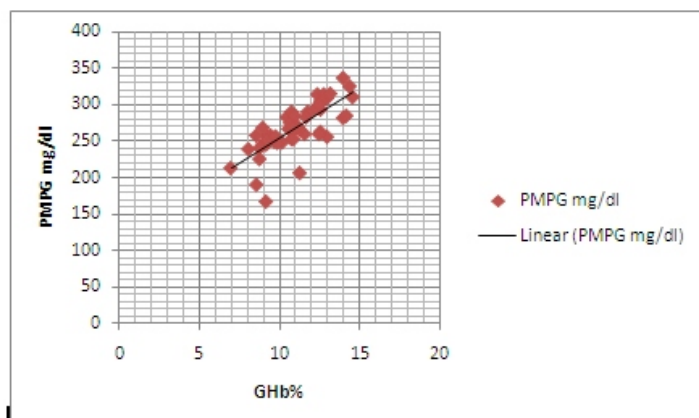
4.Discussion:

In this study, we correlated glycated hemoglobin with fasting as well as post meal plasma glucose in both type-1 & type -2 diabetic patients. Glycated hemoglobin percentage is a valuable and widely used as an adjunct to blood glucose determination for monitoring glycemic control during previous 6-8 weeks. It is a measure of risk of complications of diabetes mellitus[9]. It is strong predictor of cardiovascular risk factors, cardiovascular events & strokes in diabetic patients.[8]

GHb percentages were found to be higher in both type-1 & type-2 diabetics than that in control. Moreover GHb percentages were found to be higher in type-2 diabetics as compared to type-1 diabetics which suggested that glycemic control was poorer in type-2 diabetics than that in type-1 diabetic patients (Table NO. 2, GHb%= P<0.001) which is well correlated with the findings of many workers like Palmer AJ et al [10], V.A. Fonseca et al (1998) [11], R Paul Wadwa et al (2005)[12].

According to Monami M et al [13], 2006, Both fasting and post-prandial glucose contribute to the determination of HbA1c which supported our results as observed in Table NO. 3 & 4. But they had

stated that Fasting blood glucose could provide a greater contribution to HbA1c in patients with lower HbA1c which is in partially agreement with our results.

M Saiedullah et al (2011)[14] also revealed that fasting plasma glucose had a modest higher relation with HbA1c than 2 hours postprandial plasma glucose in the newly diagnosed diabetic subjects. It can be concluded that evaluation of FPG may provide better outcome than post meal glucose in the newly diagnosed never treated diabetic subjects.

Our study revealed that Post meal plasma glucose is high significantly & positively correlated with glycated hemoglobin rather than fasting plasma glucose in both Type-1 and Type-2 DM(P<0.001) & in control group also. We also found significant positive correlation between FPG & GHb% in all the three groups of study. The Pearson's correlation coefficient is highly significant (P<0.001) in controls as well as in Type-2 diabetics & significant (P< 0.05) in Type-1 diabetics.

Thus level of significance of correlation between PMPG and GHb% is higher than that between FPG and GHb% in all the groups of study.

Our results are well supported by Hasan Safaei at el (2003) [15], Curt L. at el (2002) [16], Rosediani M at el (2006) [17], Waqar Azim et al (2011) [18] & many similar previous studies are in strong support with our results. Curt L. Rohlfing et al (2002) [16] have concluded from their study data that fasting Plasma glucose alone should be used with caution as a measure of long-term glycemia. Fasting Plasma glucose tended to progressively underestimate HbA1c at increasing Plasma Glucose levels. Their data also suggested that Post Meal Plasma Glucose contributes appreciably to HbA1c. Results of study conducted by Rosediani M at el, 2006 [17], shows that PMBS correlates better than FBS to HbA1c. Thus, PMBS predicted overall glycaemic control better than FBS.

5.Conclusion:

Mean values of fasting as well as post meal plasma glucose are higher in type-2 diabetes mellitus as compared to type-1 DM which can prove poorer glycemic control in type-2 DM than that in type-1 DM.

Glycated hemoglobin level is high significantly and positively correlated with post meal plasma glucose values in both type-1 & type-2 diabetes mellitus. Since data to establish the correlation between plasma glucose and glycated hemoglobin in both type-1 D.M. and type-2 D.M. are scare. Thus our study suggested that post meal plasma glucose rather than fasting plasma glucose, contributes significantly to the glycated hemoglobin. Early detection of hyperglycemia & good glycemic control can prevent complications & further decreases the morbidity & Mortality.

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