

## Original Article

# GLYCATED HEMOGLOBIN PATTERN AND ITS CORRELATION WITH LIPID PROFILE IN TYPE-2 DIABETIC MALES IN CENTRAL INDIA

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## ABSTRACT

**Background:** HbA1c can be interpreted as an average of the blood glucose present over the past 3-4 months. An elevated Hb1Ac levels indicates poor control of blood glucose levels or poor glycemic index.

**Objectives:** To study the pattern of glycated hemoglobin, waist-hip ratio (WHR) and lipid profile and correlation of glycated hemoglobin with WHR and lipid profile in Type-2 diabetic males and to compare with normal study subjects.

**Materials & Methods:** Cross sectional study was carried out with the comparison group among male study subjects in the age group of 35-45 years. Group of 50 diabetic males was compared with the group of 50 normal male study subjects of the same age group from the same population. Estimation of Fasting and post meal blood sugar, lipid profile and glycated hemoglobin was done for each study subject.

**Results:** Type 2 diabetics had significantly higher mean fasting, post meal blood sugar levels, glycated Hb and lipid profile parameters except high density lipoproteins (HDL) as compared to control group. Statistically significant linear positive correlation was observed between Glycated hemoglobin and Waist-Hip ratio as well as lipid parameters except HDL in Type-2 Diabetic group. The negative significant correlation was seen between glycated Hb and HDL in type 2 diabetic group.

**Conclusion:** Type 2 diabetic males with poorly controlled diabetes had significantly deranged lipid profile as compared to normal study subjects and were at increased risk of dyslipidemias. Also the levels of glycated hemoglobin were significantly correlated with the lipid parameters and the waist hip ratio.

**Key words:** Type 2 diabetes, Glycated Hemoglobin, Waist Hip Ratio, Lipid Profile.

## INTRODUCTION

Diabetes mellitus has become a widespread disease now days. The prevalence of diabetes is rapidly rising all over the globe to an alarming rate particularly in developing nations. According to World Health Organization report 2005 around 171 million people were affected with diabetes worldwide in year 2000 and would increase to 366 million by year 2030.<sup>1</sup>

In India alone 31.7 million were affected in year 2000 and is expected to reach 79.44 million by the year 2030.<sup>1</sup> Over the past 30 years the status of diabetes has changed from being considered as mild disorder of elderly to one of the major cause of morbidity and mortality affecting youth and middle aged people.<sup>2</sup>

The maximum burden of society of diabetes is particularly contributed by Type-2 Diabetes Mellitus (DM). Type-2 diabetes accounts for about 90 percent cases of Diabetes.<sup>2</sup> And it is suggested that Type-2 Diabetes will alone afflict 250 million people by year 2010 & 300 million people by year 2025.<sup>3,4</sup>

The Major consequences of hyperglycemia are excessive non-enzymatic glycosylation of various body proteins like hemoglobin, albumin, collagen and elastin. Measurement of glycated hemoglobin (Hb1Ac) levels constitutes the Glycemic Index. Glycation occurs over the entire 90-120 day life span of the red blood cell. HbA1c can consequently be interpreted as an average of the blood glucose present over the past 3-4 months.<sup>5</sup> An elevated Hb1Ac levels indicates poor control of blood glucose levels or poor glycemic index.

Obesity, particularly visceral or central as evidenced by the Waist-Hip ratio, is very common in Type-2 Diabetes mellitus.<sup>6</sup> The Waist-hip ratio is used as an indirect measure of lower and upper body fat distribution, is also important to be assessed.<sup>1</sup>

A lot of information was available in western literature, taking into consideration the western sedentary life style habits. But little information is available in Indian diabetic population.

So, the concise study was undertaken to observe the pattern of glycated hemoglobin, waist-hip ratio (WHR), lipid profile and correlation of glycated hemoglobin with WHR, lipid profile in Indian Type-2 diabetic males and to compare them with normal study subjects.

## MATERIALS AND METHOD

This was a cross sectional study carried out with the comparison group among male study subjects in the age group of 35-45 years in Department of Physiology and Medicine of Indira Gandhi Govt. Medical College, Nagpur during January 2011. The group (Group A) of 50 diabetic males of 35-45 years age group was compared with the group of (Group B) 50 normal male study subjects (controls [comparison group]) of the same age group from the same population. The sample size was calculated on the basis of results of pilot study conducted among 20 individuals of each group. It was calculated using correlation coefficient between glycated Hb and Sr. triglycerides which was 0.398. The sample size comes out to be 47, so it was decided to include 50 study subjects in each group.

### Study Groups:

**Inclusion Criteria:** For Group A - 50 known case of Type-2 diabetic male study subjects of 35-45 years age group having Diabetes since 3 years who were willing to give consent for participation in the study. For Group B - 50 normal male subjects in the same age group (controls) who were willing to give consent for participation in the study.

**Exclusion Criteria:** Patients having tuberculosis, Asthma, Hepatic and Renal impairment, other Endocrine disorders, Diagnosed congenital or Ischemic Heart Diseases, Subjects on hypo-lipidemic drugs, Smokers and Alcoholics were excluded from the study.

The two groups were matched for the age, socioeconomic status.

**Data Collection:** The approval of the institutional ethics committee was taken. The study subjects in group A were selected from the Medicine OPD by simple random sampling method using random number table. While the study subjects in Group B were selected from the field practice area of urban health centre of Indira Gandhi Govt. Medical College, Nagpur using simple random sampling with the help of random number table.

Interview technique was used as a data collection tool followed by thorough clinical examination and the investigations. Confidentiality of study subjects was maintained throughout the study and the objectives of the study were explained to them and the informed consent was taken.

History taking included socio-demographic details, medical history, family history and personal history. All study subjects were advised to observe 12 hours overnight fasting before the investigations. Measurement of height, weight, Body Mass Index (BMI), waist and hip circumference was taken. Waist circumference was measured at the level of umbilicus and Hip circumference was measured at maximum protrusion of hip with heels together in the standing position in centimeters using the linen measuring tape. This tape was applied lightly to the skin surface so the tape remains taut but not tight. Three measurements were taken at each site and average score was taken as final measurement.<sup>7</sup> Waist to Hip ratio was calculated.

Under all aseptic precautions, 5ml each fasting and post meal samples were obtained from each study subject with the help of disposable syringe and needle. Lipid profile was estimated by enzyme kit method. Fasting as well as post meal blood sugar (PMBS) level was quantitatively estimated in the laboratory of department of biochemistry, using semi auto analyser - Transasia, ERBA, Chem-5- Plus. Estimation of Glycated Hemoglobin levels (HbA1c) was done by cation - exchange resin method.

**Statistical Analysis:** The statistical analysis of the data was performed by using Unpaired 't' test for inter group analysis of subjects. Also co-relationship between glycated hemoglobin and lipid profile parameters was ascertained by Pearson's correlation coefficient (r). P-value of < 0.05 was taken as statistically significant difference. Statistical software SSPS Version 17.0 was used for statistical analysis.

## OBSERVATIONS

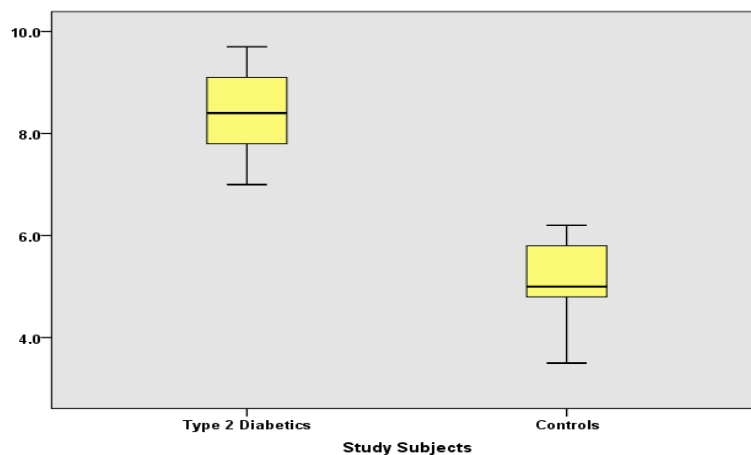
In this study 50 healthy male subjects were taken as controls and data regarding anthropometric measurements, fasting and post meal blood sugar (PMBS) levels, glycated Hb was compared with the 50 known male cases of type 2 diabetes. Also correlation was studied between the glycated Hb and Lipid parameters among type 2 diabetics and controls.

Table No. 1 shows the mean and standard deviations of the anthropometric measurements among Type 2 diabetics and controls. No statistical difference was found in the age, height, weight of Type 2 diabetic subjects and controls. BMI was in preobese range in type 2 diabetics and it was significantly higher as compared to controls. It was also observed that waist circumference and waist hip ratio were significantly higher in type 2 diabetics. However no significant difference was observed in hip circumference of type 2 diabetics and controls.

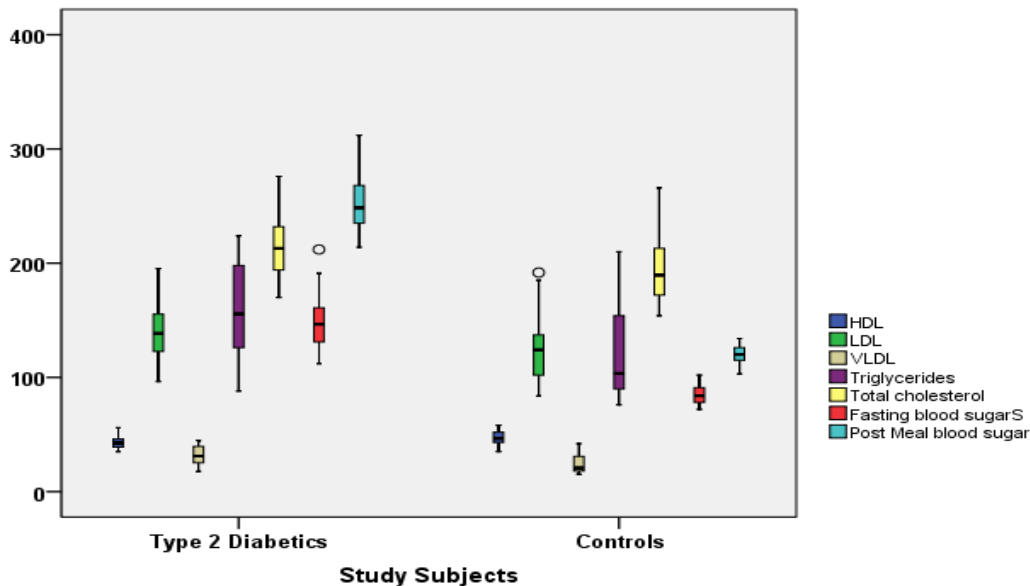
**Table 1: Anthropometric measurements amongst Type 2 diabetics and controls**

Variables	Type-2 Diabetics (n = 50)	Controls (n = 50)	P- value
Age (Years)	41.32 ± 3.26	40.48 ± 3.21	0.19
Height (meter)	1.625 ± 0.04	1.627 ± 0.035	0.79
Weight (Kg)	67.18 ± 2.68	66.1 ± 2.92	0.06
BMI (Kg/m <sup>2</sup> )	25.46 ± 1.2	24.98 ± 1.12	0.04*
Waist circumference (cm) (WC)	90.12 ± 4.13	88.57 ± 3.31	0.04*
Hip circumference in (cm) (HC)	96.84 ± 2.98	96.68 ± 2.46	0.77
Waist-Hip ratio (WHR)	0.93 ± 0.03	0.91 ± 0.03	<0.001**

\*Significant \*\*highly significant



**Fig 1: Box and Whiskers plot showing distribution of the Glycated Hb among study subjects**



**Fig 2: Box and Whiskers plot showing distribution of the blood sugar levels and lipid profile parameters among study subjects**

The comparison between distribution of blood sugar levels and lipid profile parameters between type 2 diabetics and controls was done in table 2. It was graphically represented using Box and Whiskers plot in Fig 1 and 2. It shows that Type 2 diabetics were

having significantly higher mean fasting and post meal blood sugar levels as compared to controls. Also mean glycated Hb in type 2 diabetics was  $8.41 \pm 0.74$  which was significantly higher than that of controls i.e.  $5.10 \pm 0.73$ .

**Table 2: Distribution of the blood sugar levels and lipid profile parameters among Type 2 Diabetics and controls**

Variables	Type-2 DM	Controls	P- value
Fasting Blood Sugar (FBS) (mg %)	148.78 ± 22.5	84.92 ± 7.94	<0.001**
PMBS (mg %)	253.24 ± 23.38	119.84 ± 7.48	<0.001**
Glycated Hb (%)	8.41 ± 0.74	5.10 ± 0.73	<0.001**
Total Cholesterol(TC) (mg/dl)	214.9 ± 27.88	194.9 ± 27.10	<0.001**
Triglycerides(TG) (mg/dl)	158.1 ± 41.72	121.68 ± 40.16	<0.001**
LDL (mg/dl)	140.24 ± 25.6	123.5 ± 25.49	<0.05*
VLDL (mg/dl)	31.62 ± 8.34	24.34 ± 8.03	<0.001**
HDL (mg/dl)	43.00 ± 5.06	47.06 ± 5.46	<0.001**

\*\*Highly Significant

The Serum total cholesterol, triglycerides, Low density lipoproteins (LDL), Very low density lipoproteins (VLDL) were significantly higher in Type-2 Diabetic group as compared to control group. While serum high density lipoproteins (HDL) concentration was found to be significantly lower in Type-2 diabetics as compared to that in control group. The average values of all parameters of serum Lipid profile in Type 2 DM group were in borderline high-risk range.

**Table No. 3: Correlation of Glycated Hemoglobin with Waist-Hip ratio and lipid parameters in study groups.**

Study variables	Type 2 Diabetics		Controls	
	r-value	p value	r-value	p value
Gycated Hb	1		1	
Waist hip ratio	0.349	0.013*	0.148	0.306
Total cholesterol	0.313	0.027*	0.146	0.312
Tryglycerides	0.452	0.001*	0.134	0.352
VLDL	0.452	0.001*	0.134	0.352
LDL	0.252	0.009*	0.137	0.344
HDL	-0.281	0.001*	-0.111	0.441

\*Significant

Correlation of glycated Hb with Waist-Hip ratio and lipid parameters among both study and control group was studied in table no.3.

It was observed that, there was statistically significant linear positive correlation between Glycated hemoglobin and Waist-Hip ratio as well as lipid parameters except HDL in Type-2 Diabetic group. The negative significant correlation was seen between glycated Hb and HDL in type 2 diabetic group.

No such significant correlation was observed between glycated Hb and Lipid parameters as well as waist hip ratio in control group.

## DISCUSSION

In this study it was observed that type 2 diabetics had significantly higher BMI of Preobese range than controls. The findings were in agreement with those observed by Abbasi F (2002)<sup>8</sup>, Hettihewa LM (2007)<sup>9</sup>. WHR is convenient and simple measurement that is

unrelated to height, correlates closely with BMI and is an approximate index of intra-abdominal fat mass and total body fat. There is an increased risk of metabolic complications for men with a waist circumference ≥ 102 cm, and women with a waist circumference ≥ 88 cm. A higher WHR reflects a greater proportion of abdominal fat with greater risk for hyper insulinemia, insulin resistance, type 2 diabetes, endometrial cancer, hypercholesterolemia, hypertension and atherosclerosis.<sup>10</sup> In our study type 2 diabetics had significantly higher Waist Circumference (WC) & Waist-Hip ratio than controls. These findings were similar to those observed by Arora M et al (2007)<sup>11</sup>, Vazquez G et al (2007)<sup>12</sup>, Qiao Q et al(2010)<sup>13</sup>, Wang Y (2005)<sup>14</sup>.

It was suggested that activation of the central nervous system- adrenal axis by environmental stressors cause both the preferential deposition of adipose tissue in the trunk and metabolic disorders associated with that deposition.<sup>15</sup> More recently, it had been suggested that a limited ability of subcutaneous fat depots to store excess energy results in an "overflow" of chemical energy to intra abdominal and "ectopic" sites, such as liver and skeletal muscle. Excessive ectopic fat accumulation then causes metabolic dysfunction in those organs. In fact, increased intrahepatic fat is associated with dyslipidemia and hepatic insulin resistance<sup>16</sup>,and increased intramyocellular fat is associated with skeletal muscle insulin resistance.<sup>17</sup>

Another hypothesis proposes a direct effect of omental and mesenteric adipose tissue depots on insulin resistance & lipoprotein metabolism. Metabolic products of omental and mesenteric adipose tissue depots are released into the portal vein, which provides direct delivery to the liver. Lipolysis of omental and mesenteric adipose tissue triacylglycerols releases free fatty acids that can induce hepatic insulin resistance and provide substrate for lipoprotein synthesis and neutral lipid storage in hepatocytes. Also specific proteins and hormones are produced by omental and mesenteric adipose tissue, such as adipokines, angiotensinogen, and cortisol can also contribute to cardiometabolic disease.<sup>15</sup>

It was observed that the Type 2 Diabetics had significantly higher fasting as well as post meal blood sugar levels as compared to controls. Also the glycated hemoglobin level was significantly higher in type 2 di-



abetic patients. This indicates that the diabetic subjects had impaired blood sugar control indicating poorly controlled Diabetes.

In our study it was found that serum Cholesterol, triglycerides, VLDL, LDL were significantly higher in Type-2 Diabetic group than controls and were in borderline high risk range. While Serum HDL was significantly lower in Type-2 Diabetic group than controls and was towards lower range of normal value. The findings were in agreement with Taha D et al (2002)<sup>18</sup>, Watson KE et al (2003)<sup>19</sup>.

Normally Insulin plays important role in inhibiting intracellular hormone sensitive lipases of adipose tissue and activating lipoprotein lipase because of lack of insulin action in Type-2 Diabetes Mellitus, the activity of lipoprotein lipase gets depressed whereas the activity of hormone sensitive lipase increases. Also because of insulin deficiency in DM, glucose cannot be utilized for energy purposes by the cells. Thus there is increased lipolysis leading to increased FFA (Free Fatty Acids) which are then catabolized to acetylCoA in Liver and other tissues. Due to deficiency of acetyl CoA carboxylase in DM;(the Enzyme that converts acetyl CoA to malonyl CoA) there is no conversion of acetyl CoA to Malonyl CoA. Hence excess acetyl CoA gets converted to more & more cholesterol & its concentration in blood rises in Type-2 DM. VLDL & LDL increases either because of increased hepatic production of VLDL or decreased removal of VLDL and LDL from circulation. Serum concentration of triglycerides also increases because of decreased removal from circulation.<sup>20</sup> Serum HDL concentration decreases due to excess catabolism and also there was negative relationship between HDL concentration and LDL concentration. Hence Hyperglycemia is related with deranged Lipid Profile and this may lead to dyslipidemia.

In this study statistically significant linear positive correlation was observed between Glycated Hemoglobin and Waist-Hip ratio as well as lipid parameters except HDL in Type-2 Diabetic group. The negative significant correlation was seen between glycated Hb and HDL in type 2 diabetic group. The above finding were in agreement with the findings studied by Lewis GF et al (2002)<sup>21</sup>, Arora M et al (2007).<sup>11</sup>

### Conclusions and Recommendations

Based on the above findings it can be concluded that type 2 diabetic males with poorly controlled diabetes had significantly deranged lipid profile as compared to normal study subjects and were at increased risk of dyslipidemias. Also the levels of glycated hemoglobin were significantly correlated with the lipid parameters and the waist hip ratio. Hence it was recommended that the glycemic control in terms of glycated hemoglobin should be achieved so as to decrease the risk of deranged lipid profile and subsequently the risk of cardio metabolic changes.

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