

Study on correlation between glycated haemoglobin and serum lipid profile in type 2 diabetes mellitus

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Abstract

Background: Diabetes Mellitus is the most common endocrine disease leading on to long term complications involving eyes, kidneys, nerves and blood vessels. Lipid abnormality is one of the major contributory factor increasing the risk of development of cardiovascular disease in type-2 Diabetes Mellitus. This study was undertaken to look for the correlation between glycated haemoglobin (HbA1c) and serum Lipid profile parameters in type-2 Diabetes Mellitus. **Aim:** To study the correlation between glycated haemoglobin (HbA1c) and serum lipid profile levels in type-2 Diabetes Mellitus. **Materials and Methods:** The study group consisted of 150 patients with type-2 Diabetes Mellitus and 150 normal healthy people without Diabetes of age (40-70) years. Both fasting and post prandial blood samples were collected and the blood samples were used for fasting blood sugar, post prandial blood sugar, HbA1c and serum lipid profile analysis. Pearson's correlation coefficient was used to find out the correlation between HbA1c and serum Lipid profile in type-2 Diabetes Mellitus. **Results:** There was a statistically significant increase in the mean HbA1C values in the Diabetic group when compared to the non-diabetic group ($P < 0.01$), whereas, a statistically significant increase was observed in the levels of serum Total cholesterol, TGL, LDL and VLDL cholesterol. There was a statistically significant decrease in serum HDL cholesterol levels in the Diabetic group when compared to the healthy non-Diabetic group ($P < 0.01$). There was a statistically significant positive correlation ($P\text{-value} = 0.00$) between HbA1c and serum Total cholesterol, TGL, LDL and VLDL cholesterol in type 2 Diabetic patients. Also, there was a statistically significant negative correlation ($r = -0.30, P\text{-value} = 0.00$) between HbA1c and serum HDL cholesterol in type 2 Diabetic patients. **Conclusion:** Dyslipidemia is commonly observed in type 2 Diabetes Mellitus patients with poor glycemic control.

Key Words: Correlation, Glycated Haemoglobin (HbA1c), Lipid profile, Type-2 Diabetes Mellitus

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INTRODUCTION

WHO consultation report defines 'Diabetes Mellitus' as a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with defects in carbohydrate, fat and protein metabolism resulting from defective Insulin secretion, Insulin action or both.¹ The number of diabetic

patients worldwide is estimated to be around 150 million, two-thirds of these people belong to developing countries. India alone accounts for 20 million diabetic subjects.² The long term effects of Diabetes Mellitus include progressive development of specific complications of retinopathy with potential blindness, nephropathy leading to renal failure, risk of foot ulcer and features of autonomic dysfunction including sexual dysfunction.³ Of all the complications caused by Diabetes Mellitus, the most dangerous and life threatening one is the coronary artery disease (CAD). Diabetic patients have more than two-fold higher risk of developing coronary artery disease compared to non-diabetic subjects.⁴ As hyperglycaemia is strongly associated with the development and progression of diabetic complications, the need for accurate monitoring of blood glucose levels in diabetes is essential. It has been known since the early 1970's that glucose can attach to many proteins, and one such protein

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is haemoglobin.⁵ The non-enzymatic addition of a sugar residue to the amino group of proteins is called glycation. Glycated haemoglobin (HbA1c) is formed by the addition of glucose to the N-terminal valine residue of the β -chain of haemoglobin. HbA1c constitutes 60-80% of the total glycated haemoglobin. HbA1c is formed within the red-blood cells at a rate directly proportional to the blood glucose concentrations and reflects the mean blood glucose levels over the previous six to eight weeks.⁶ The measurement of glycated haemoglobin, especially HbA1c is effective in monitoring long-term blood glucose control in people with Diabetes Mellitus. It provides a retrospective index of integrated plasma glucose values over an extended period of time and is unaffected by recent food intake or recent changes in blood sugar levels. Lipid abnormality is one of the major contributory factor for the increased risk of development of cardiovascular disease in diabetes.⁷ Hypertriglyceridemia, increased serum cholesterol and increased levels of LDL lipoproteins have been reported in diabetics.⁸ Among these abnormalities hypertriglyceridemia is the most common and is caused by a defective clearance of triglycerides.⁹ The enzymes lipoprotein lipase and hormone sensitive lipase which are essential for clearance of lipoproteins are found to have decreased activity in Insulin Dependent Diabetes Mellitus (IDDM) and mildly decreased activity in Non-Insulin Dependent Diabetes Mellitus (NIDDM).^{10,11} Hence control of blood glucose levels is vital in Diabetes Mellitus and HbA1c is a preferred index of long-term control of blood glucose. The present study was undertaken to look for the correlation between glycated haemoglobin (HbA1C) and serum lipid profile parameters in Diabetes mellitus.

MATERIALS AND METHODS

This study is a case control study which was carried out in 150 people with type-2 Diabetes Mellitus and 150 normal healthy people without Diabetes visiting the Department of Medicine of Sree Mookambika Institute of Medical Sciences Hospital, Kulasekharam. The age group of the study subjects were (40-70) years. Ethical approval was obtained from the Institutional Ethical Committee and an informed consent was obtained from all the participants of the study. Blood samples collected from the study participants were assayed for fasting blood sugar, post prandial blood sugar, HbA1c and serum lipid profile determination using Beckmann Coulters Au480 fully automated analyser and Erba Transasia's Chem 5 plus semi autoanalyser in the Clinical Biochemistry Laboratory of SreeMookambika Institute of Medical Sciences. HbA1c percentage was analysed by cation-exchange resin method using Glyco Haemoglobin reagent

kit. Serum lipid profile levels were analysed by enzymatic kit methods.

Statistical method of analysis

Statistical analysis was done using SPSS statistical package version 21. Results were expressed in terms of Mean \pm SD. Unpaired student's t-test was used to compare the results between the diabetic and non-diabetic group. Pearson's correlation coefficient was used to find out the correlation between serum lipid profile levels with HbA1c levels in type-2 Diabetic patients. Statistically significant variation was considered when p value was less than 0.05.

RESULTS

A significant positive correlation was observed between HbA1c and serum total cholesterol ($r=0.497$), serum triglyceride ($r=0.344$), serum LDL-cholesterol ($r=0.508$) and VLDL-cholesterol ($r=0.344$) levels in diabetic patients as seen in Fig (1.1, 1.2, 1.4 and 1.5). There was a significant negative correlation ($r=-0.300$) between HbA1c and serum HDL-cholesterol levels in the diabetic patients as seen in Fig 1.3. Table I shows that, there is a statistically significant difference in the mean HbA1C values in the Diabetic group when compared to the non-diabetic group ($P<0.01$). Similarly, a statistically significant difference exists in the levels of Total cholesterol, TGL, HDL, LDL and VLDL in the Diabetic group when compared to the healthy group. The difference is found to be highly significant ($P<0.01$) for Total cholesterol, LDL and VLDL values in Diabetic patients when compared to controls. Table II evaluates the effect of known duration of Diabetes on glycated haemoglobin and serum lipid levels. From this table, it is seen that, there is a highly statistically significant effect of increased duration of diabetes on HbA1c, Total cholesterol and LDL Cholesterol levels ($p<0.01$). Also, there is a statistically significant increase in the TGL and VLDL Cholesterol levels ($p<0.05$) with increased duration of diabetes. From this table, it is also found that, there is no statistically significant effect of increased duration of diabetes on HDL cholesterol levels. Table III shows the effect of treatment with Oral hypoglycemics, Oral hypoglycemics and insulin, treatment with insulin alone on the levels of glycated hemoglobin and serum lipid levels in diabetic patients. From this Table it is seen that treatment showed highly statistically significant effects on the HbA1c, Total Cholesterol and LDL Cholesterol levels in Diabetic patients ($P<0.01$). Also, there is a statistically significant effect of treatment on TGL and VLDL Cholesterol levels in Diabetic patients ($P<0.05$). From this table it is found that there is no statistically significant effect of treatment on HDL Cholesterol levels ($p>0.05$).

CORRELATION BETWEEN GLYCATED HEMOGLOBIN and SERUM LIPID PROFILE IN DIABETIC PATIENTS

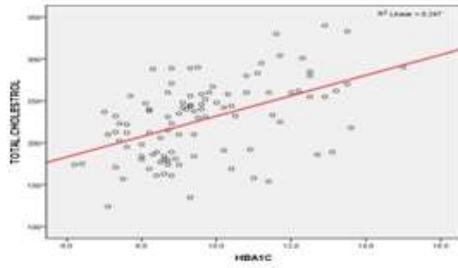


Fig 1.1: Total cholesterol andHbA1c

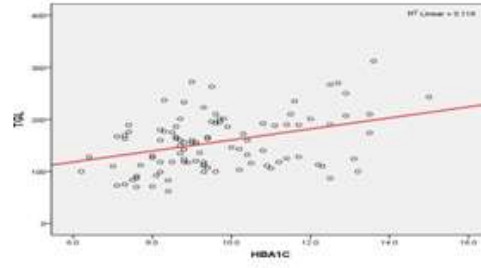


Fig 1.2: TGL and HbA1c

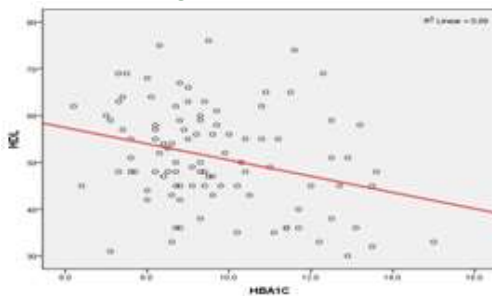


Fig 1.3: HDL andHbA1c

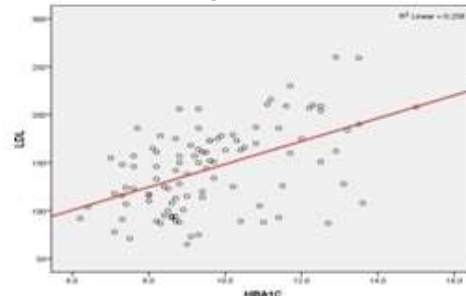


Fig 1.4: LDL andHbA1c

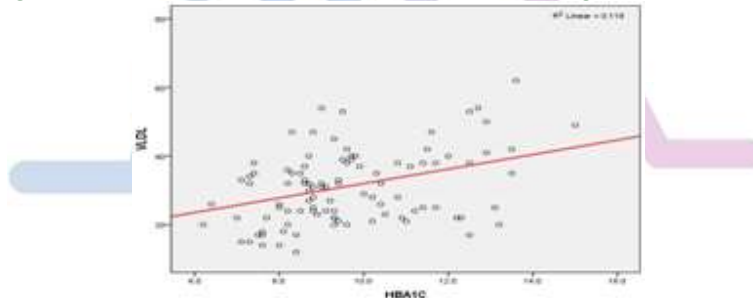


Fig 1.5: VLDL and HbA1c

TABLE I: COMPARISON OF HbA1C AND LIPID LEVELS BETWEEN DIABETIC AND NON-DIABETIC

	Diabetic Group	Non-Diabetic Group	Overall	F-Value	p-Value
HbA1C	9.64±1.86	5.51±0.31	8.26±2.47	242.19	0.000**
Tot. cholesterol	227.46±67.52	186.20±15.76	213.71±42.87	38.69	0.000**
TGL	156.59±57.13	135.32±19.44	149.50±48.96	6.524	0.012*
HDL	51.14±10.72	55.52±7.17	52.60±9.87	6.814	0.010*
LDL	144.13±43.62	103.88±17.49	130.71±41.56	39.29	0.000**
VLDL	31.23±11.41	26.80±3.85	29.75±9.79	7.110	0.009**

* Statistically significant –P Value<0.05 ** Statistically significant –P Value<0.01

TABLE II: EFFECT OF KNOWN DURATION OF DIABETES ON GLYCATED HEMOGLOBIN AND SERUM LIPID LEVELS

	Duration	N	Mean±SD	Overall	F-Value	P-Value
HbA1C	Longer Duration	39	10.695±1.7957	9.635±1.8562	26.137	0.000**
	Shorter Duration	61	8.957±1.5639			
Tot. Cholesterol	Longer Duration	39	247.05±44.841	227.46±45.493	13.334	0.000**
	Shorter Duration	61	214.93±41.623			
TGL	Longer Duration	39	172.69±56.042	156.59±57.173	5.291	0.024*
	Shorter Duration	61	146.30±55.928			

HDL	Longer Duration	39	48.90±11.392	51.14±10.717	2.852	0.094
	Shorter Duration	61	52.57±10.097			
LDL	Longer Duration	39	163.69±44.421	144.13±43.624	14.626	0.000**
	Shorter Duration	61	131.62±38.504			
VLDL	Longer Duration	39	34.44±11.213	31.23±11.4111	5.263	0.024*
	Shorter Duration	61	29.18±11.148			

*Statistically significant - p Value < 0.05 **Statistically significant – p Value < 0.01

TABLE III: INFLUENCE OF TREATMENT ON THE LEVELS OF GLYCATED HEMOGLOBIN AND SERUM LIPID PROFILE IN DIABETIC PATIENTS

	TREATMENT	N	Mean±SD	Overall	F-Value	P-Value
HbA1C	Insulin	4	12.150±2.056	9.635±1.8562	19.071	0.000**
	OHA	81	9.163±1.561			
	OHA + Insulin	15	11.513±1.627			
Total Cholesterol	Insulin	4	275.75±30.40	227.46±45.493	7.468	0.001**
	OHA	81	219.62±41.77			
	OHA+ Insulin	15	256.93±50.12			
TGL	Insulin	4	165.25±63.87	156.59±57.173	3.406	0.037*
	OHA	81	149.88±55.92			
	OHA+ Insulin	15	190.53±53.39			
HDL	Insulin	4	50.00±15.535	51.14±10.717	1.137	0.325
	OHA	81	51.89±10.338			
	OHA+ Insulin	15	47.40±11.451			
LDL	Insulin	4	192.75±20.646	144.13±43.62	7.481	0.001**
	OHA	81	136.67±38.427			
	OHA +Insulin	15	171.47±55.946			
VLDL	Insulin	4	33.00±12.936	31.25±11.411	3.405	0.037*
	OHA	81	29.89±11.164			
	OHA +Insulin	15	38.00±10.603			

*Statistically significant - p Value < 0.05 **Statistically significant - p Value < 0.01

DISCUSSION

In our study, the mean values of glycated haemoglobin in diabetic patients and non-diabetic controls were 9.64±1.86 and 5.51±0.31 respectively. This shows that, the mean values of glycated haemoglobin in diabetic patients were higher when compared to the non-diabetic controls. The increase was found to be highly statistically significant. Similar findings were also observed in another study done by Pasupathi P *et al.*¹² Results in our study (table-1) shows that, the mean values of serum Total cholesterol, serum Triglycerides, serum LDL-cholesterol and serum VLDL-cholesterol in the diabetic patients were 227.46± 67.52, 156.59±57.13, 144.13±43.62 and 31.23± 11.41 respectively. These values were higher than the mean values observed in non-diabetic healthy controls which were 186.20± 15.76, 135.32 ±19.44, 103.88± 17.49 and 26.80± 3.85 respectively. This increase was found to be statistically significant (p<0.05). Similar findings were observed in a study done by Samatha P.¹³ In that study, the mean total cholesterol, triglyceride and LDL-cholesterol levels were increased in the diabetic patients when compared to the controls. Similar findings were also observed in studies done by IdogunES¹⁴ and AlbrkiWM.¹⁵ In this study, a significant positive correlation was observed between

HbA1c and serum total cholesterol (r=0.497), serum triglyceride (r= 0.344), serum LDL-cholesterol (r=0.508) and VLDL-cholesterol (r=0.344) levels in diabetic patients. There was a significant negative correlation (r=-0.300) between HbA1c and serum HDL-cholesterol levels in the diabetic patients. These findings were in agreement with the study done by Khan HA.¹⁶ Diabetic patients with elevated HbA1c and serum lipid values are considered very high-risk group for cardiovascular disease (CVD). Significant correlations between HbA1c and the lipid parameters and a linear relationship between HbA1c and dyslipidemia point towards the usefulness of HbA1c for screening high-risk diabetic patients. It has been estimated that reducing HbA1c levels by 0.2% could lower the cardiovascular risk by 10%.¹⁷ In this study, longer duration of diabetes showed statistically significant effect on HbA1c, Total cholesterol, LDL-cholesterol, VLDL-cholesterol and TGL levels (p value <0.05). There was a highly statistically significant effect of longer duration of diabetes on HbA1c, Total cholesterol and LDL-cholesterol levels (p value<0.01). These findings were found to be similar to a study done by Rashid A and Haider I.¹⁸ Effective treatment either with oral hypoglycemic agents or Insulin showed statistically significant effects on HbA1c, serum total

cholesterol and LDL-cholesterol levels in diabetic patients. Diabetic care with diet and exercise modifications or medications have a great impact in lowering blood glucose levels, serum total cholesterol levels and LDL- cholesterol levels.¹⁹ Micro vascular complications are reduced by 25% by effective diabetic treatment. There is a 35% reduction in risk of developing micro vascular complications with every 1% decrease in HbA1c levels.

CONCLUSION

From the analysis of results obtained in type-2 diabetic patients and healthy age and sex matched controls without diabetes, the following conclusions were made:

1. There was a statistically significant difference in HbA1c, serum Total Cholesterol, LDL-Cholesterol, VLDL-Cholesterol and Triglyceride levels in diabetic patients when compared to healthy controls without diabetes.
2. There was a significant positive correlation between HbA1c and serum Total Cholesterol, serum LDL-cholesterol, serum Triglyceride and serum VLDL- Cholesterol in diabetic patients.
3. There was a statistically significant negative correlation between HbA1c and serum HDL-cholesterol levels in diabetic patients. Thus, in addition to monitoring blood glucose levels, HbA1c provides valuable information about the level of circulating lipids. This may be utilized for screening high risk diabetes patients for timely intervention with lipid lowering drugs.
4. There was a statistically significant effect of duration of diabetes on HbA1c, serum Total Cholesterol, serum LDL-Cholesterol, serum Triglyceride and serum VLDL- Cholesterol levels.
5. Effective treatment in diabetic patients showed statistically significant decrease in HbA1c, serum Total Cholesterol, serum LDL-Cholesterol, serum VLDL-Cholesterol and serum Triglyceride levels.

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