Original Article

Relationship of Glycated Haemoglobin with Lipid Profile among Patients with Type 2 Diabetes Mellitus

Samdani TS[a], Mitra P[b], Rahim MA[c]

Abstract

Background: *Glycated hemoglobin (HbA1c) is widely used as an index of mean glycaemia, a measure of risk for the development of diabetic complications and a measure of the quality of diabetes care. Patients with type 2 diabetes have an increased prevalence of dyslipidemia. Treatment of dyslipidaemia improves cardiovascular outcomes. The aim of this study was to determine the impact of glycemic control on lipid profile.*

Methods: *This cross-sectional study was conducted among 300 type 2 diabetic patients admitted in BIRDEM General Hospital from November 2013 to April 2015. Fasting blood samples were collected and different lipid fractions along with fasting blood glucose and HbA1c were estimated. Pearson's correlation test was applied to evaluate the correlation between HbA1c and components of lipid profile.*

Results: *The mean value of total cholesterol (TC), triglyceride (TG), low density lipoprotein-cholesterol (LDL-C), fasting blood glucose (FBG) and HbA1c were higher and high density lipoprotein-cholesterol (HDL-C) was lower in females when compared with these values for males. HbA1c had significant positive correlation with LDL-C (p=0.045) and negative correlation with HDL-C (p=0.024). Serum lipid profile and glycaemic controls were significantly (p=0.000) better in older age group (age ≥ 50 years).*

Conclusions: *Significant positive correlation of HbA1c with lipid profiles specially LDL-C suggested that HbA1c can also be used as predictor of dyslipidemia in addition to glycemic control.*

Key words: *Correlation, diabetes mellitus, glycated haemoglobin, serum lipid profile.*

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Introduction

Diabetes mellitus (DM) is rapidly increasing in both developing and developed countries. [1,2] Globally 347 million people are suffering from DM and World Health Organization (WHO) projects that diabetes will be the 7th leading cause of death in 2030.[3,4] Type 2 diabetes mellitus (T2DM) is often associated with both qualitative and quantitative abnormalities of lipoproteins which are responsible for increased incidence of microvascular and macrovascular complications.[5]

Author Informations

a. Dr. Tasrina Shamnaz Samdani, Assistant Professor, Medicine, Delta Medical College and Hospital, Dhaka, Bangladesh.

b. Dr. Palash Mitra, Assistant Registrar, Nephrology, BIRDEM General Hospital, Dhaka, Bangladesh.

c. Dr. Muhammad Abdur Rahim, Assistant Professor, Nephrology, BIRDEM General Hospital, Dhaka, Bangladesh.

Address of correspondence: Dr. Tasrina Shamnaz Samdani, Assistant Professor, Medicine, Delta Medical College and Hospital, Dhaka, Bangladesh. Email: tasrina20@gmail.com

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American Diabetes Association (ADA) proposed the use of glycated haemoglobin (HbA1c) in the definition of diabetes and the category of increased diabetes risk [which also includes impaired fasting glucose (IFG) and impaired glucose tolerance (IGT)] in 2010.[6] Estimated risk of cardiovascular disease (CVD) has shown to be increased by 18% for each 1% increase in absolute HbA1c value in diabetic population.[7]

International Diabetic Federation (IDF) has designated HbA1c level of <7% as a goal of optimal blood glucose control and the American Association of Clinical Endocrinologist has further recommended HbA1c level of <6.5% as target of glycaemic control .[8, 9] Criteria for abnormal lipid profiles were based on the ADA criteria; hypercholesterolemia refers to a total cholesterol level ≥ 200 mg/dl, hypertriglyceridemia refers to a level ≥ 150 mg/dl, HDL is considered low when the level is < 40 mg/dl in males and < 50 mg/dl in females, LDL is considered high when the level is ≥ 100 mg/dl. Dyslipidemia is defined as the presence of one or more of the abnormalities in serum lipids. [10] The aim of this

study was to evaluate the relationship among HbA1c and lipid profile in selected Bangladeshi T2DM patients.

Methods

In this cross-sectional study, a total of 300 type 2 diabetic patients (108 males and 192 females), admitted in Bangladesh Institute of Research and Rehabilitation in Diabetes, endocrine and Metabolic Disorders (BIRDEM) General Hospital, Dhaka, Bangladesh, from November 2013 to April 2015 were included. Venous blood samples were collected from all the subjects after at least 8 hours fasting. Blood specimens were collected for HbA1c in Serum Separator Tube for fasting glucose (FBG) and lipid profile measurement. All the biochemical analyses were performed in the Laboratory of BIRDEM General Hospital, Dhaka, Bangladesh. Serum was used for analyzing lipid profile, which includes total cholesterol (TC), HDL-cholesterol (HDL-C), triglycerides (TAG) and LDL-cholesterol (LDL-C) was calculated.

The data were analyzed by statistical package (SPSS) version 20.0. Independent sample t-test (2-tailed) was used to compare means of different parameters. Pearson's correlation test was performed to examine various correlations. The value of HbA1c was given as percentage of total hemoglobin (%) and values of lipid fractions were given in mg/dl. All values are expressed as mean ± standard deviation. The results were considered significant when $P < 0.05$.

Results

Three hundred consecutive patients with T2DM were evaluated (108 males, 192 females). The mean age of males and females was 57.42 ± 10.67 and 53.31 ±9.71 years respectively. Base-line characteristics are presented in Table I. The mean value of TC, TG, LDL-C, FBG and HbA1c were higher and HDL-C was lower in female in comparison to male and it was significant for TC, TG, HDL-C and LDL-C (Table II). Glycaemic status (HbA1c) had impact on fasting blood glucose and components of lipid profile (Table III, IV and Figures 1-5). Serum lipid profile and glycaemic index were significantly (p=0.000) well controlled in older age group (age ≥ 50 years) patients (Table V).

Table I. Base-line characteristics of the study subjects (N=300)

Characteristics	Value
Total number of patients	300
Male:Female	1:1.8
Rural: urban: sub-urban	90:138:72
Mean duration of diabetes (years)	11.4 ± 8.0
Mean HbA1c (%)	8.9 ± 1.9
Mean BMI (kg/m^2)	24.3 ± 4.6

Table II. Status of serum lipid profile and HbA1c in all subjects

Parameters	Total (N=300)	Male (n=108)	Female (n=192)	p-Value
T. Chol (mg/dl)	167.07 ± 55.66	145.36 ± 45.22	180.26 ± 56.99	0.000
TG (mg/dl)	164.37 ± 89.30	146.36 ± 87.28	177.39 ± 89.93	0.046
LDL-C (mg/dl)	95.34 ± 44.54	79.27 ± 33.65	104.50 ± 48.10	0.000
HDL-C (mg/dl)	29.54 ± 14.30	32.05 ± 19.05	28.00 ± 10.75	0.045
HbA1c (%)	8.9 ± 1.9	8.50 ± 1.27	9.23 ± 2.11	0.103

Table III. Frequency of abnormal lipid status in all subjects and relation with HbA1c

Status	Frequency (%)	HbA1c <7 (%)	HbA1c ≥7 (%)	*p* value
Hyper-cholesterolemia	45 (15%)	06	39	0.728
Hyper-tryglycemia	97 (32.33%)	15	82	0.873
High LDL	102 (34%)	12	90	0.258
Low HDL	165 (55%)	24	141	0.810
No abnormal lipid profile	127 (42.33%)	21	106	0.522
One abnormal lipid profile	35 (11.67%)	03	32	0.258
Two abnormal lipid profile	72 (24%)	12	60	0.653
More than two abnormal lipid profile	66 (22%)	09	57	0.726

Table IV. Relationship between HbA1c and components of serum lipid profile as reflected by Pearson correlation

		HbA1c
HbA1c	Pearson Correlation	1
	Sig. (2-tailed)	
	N	300
TC	Pearson Correlation	0.093
	Sig. (2-tailed)	0.204
	N	300
TG	Pearson Correlation	0.117
	Sig. (2-tailed)	0.114
	N	300
HDL-C	Pearson Correlation	-0.167*
	Sig. (2-tailed)	0.024
	N	300
LDL-C	Pearson Correlation	0.017*
	Sig. (2-tailed)	0.045
	N	300
FBG	Pearson Correlation	0.677**
	Sig. (2-tailed)	0.000
	N	300

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table V. S. Lipid profile and glycemic indices (HbA1c and FBG) in all subjects according to age group

Parameter	Age ≥50 years (n=78)	Age <50 years (n=222)	p-Value
T. Chol	156.82 ± 38.33	169.28 ± 58.60	0.000
TG	146.64 ± 61.45	168.27 ± 94.04	0.000
HDL	27.55 ± 6.61	29.98 ± 15.47	0.000
LDL	82.18 ± 29.83	98.30 ± 46.79	0.000
FBG	10.12 ± 3.79	10.45 ± 4.29	0.000
HbA1c	8.83 ± 1.82	8.96 ± 2.22	0.000

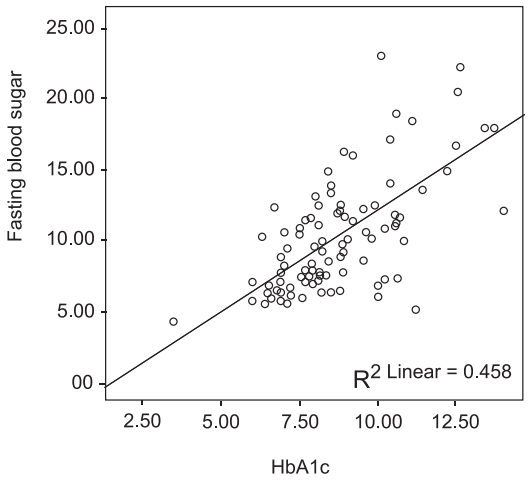

Figure 1: *Relationship between HbA1c and FBG (Pearson Correlation)*

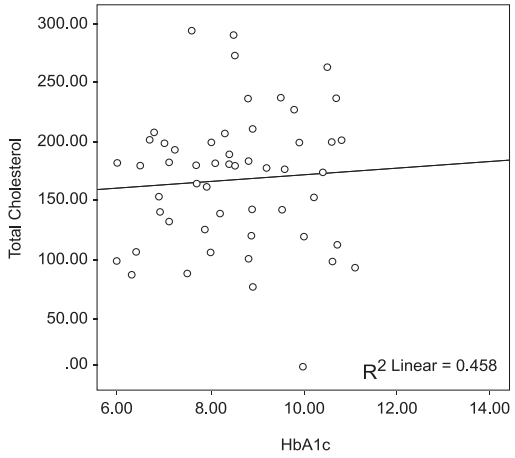

Figure 2: *Relationship between HbA1c and TC (Pearson Correlation)*

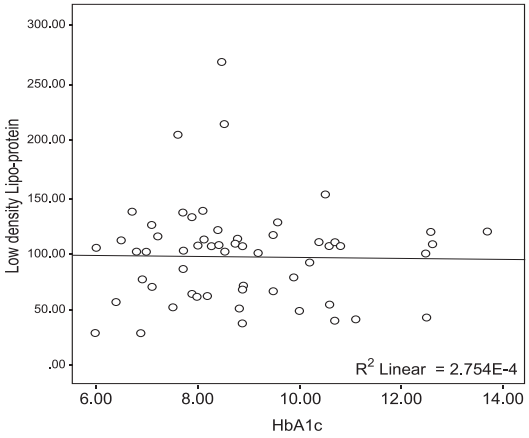

Figure 3: *Relationship between HbA1c and LDL-C (Pearson Correlation)*

elevated HbA1c and dyslipidaemia can be considered as a very high risk group for CVD. Improving glycemic control can substantially reduce the risk of cardiovascular events in diabetics.[18] It has been reported that reducing the HbA1c level by 0.2% could lower the mortality by 10%.[19] The results of the present study also suggest the importance of glycemic control to manage dyslipidaemia and risk for cardiovascular diseases in type 2 diabetics.

In conclusion, a significant correlation exists between HbA1c and lipid profile. Better glycemic control reflected by HbA1c would also reflect better lipidemic state. Achieving the target HbA1c will contribute in improving the lipid state, and hence may lessen the diabetic complications in type 2 diabetic patients. HbA1c can be used as an indicator of glycemic control as well as a predictor of dyslipidaemia in T2DM patients.

Conflict of interest: None

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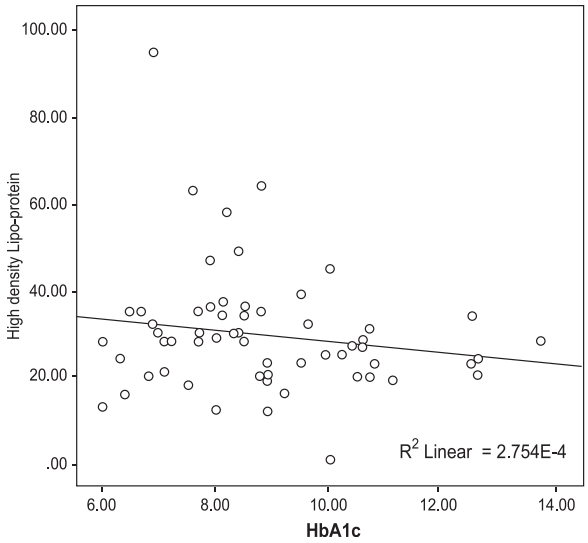

Figure 4: *Relationship between HbA1c and HDL-C (Pearson Correlation)*

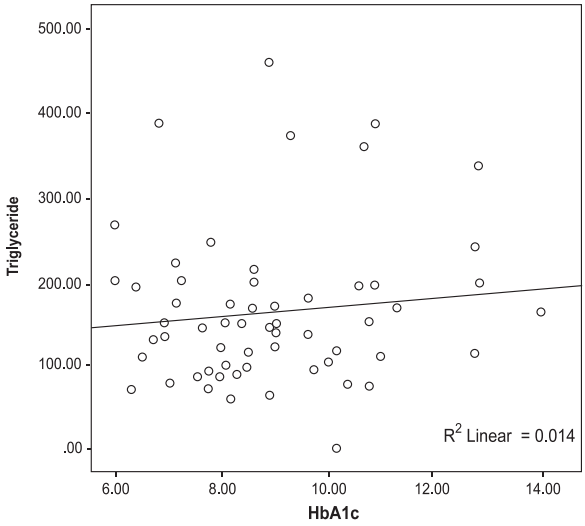

Figure 5: *Relationship between HbA1c and TG (Pearson Correlation)*

Discussion

In the present study, we have evaluated the pattern of lipid profile in T2DM patients and its correlation with HbA1c. The levels of TC, TG, LDL-C and HDL-C differ significantly between male and female subjects. On the other hand, there was no significant difference in FBG and HbA1c between the male and female patients. The level of HDL-C was significantly lower in female as compared to male type 2 diabetics. This may reflect better adherence to diabetic management by male patients. This study also reveals moderate high prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL-C and low HDL.C levels. The main lipid abnormality in our diabetic patients was high TC and LDL-C levels. The levels of TC, TG, HDL-C, LDL-C, FBS and HbA1c were significantly different between those aged ≥50 years and <50 years old patients. This may also reflect better patients' adherence to diabetes and lipid management in older age group. Similarly, study done by Al Lawati et al reported that the younger Omani type 2 diabetics exhibited worse glycemic state compared to older patients. A highly significant correlation between HbA1c and FBS was noted in this study.[11] Similarly, significant correlations between HbA1c and TC were observed by Gimeno-Orna JA et al in a prospective cohort study which included 418 type 2 diabetics with follow-up until the appearance of cardiovascular disorders.[12] In this regard it is worth to state that small LDL-C particles are increased in diabetes and this metabolic indicator is indirectly reflected by LDL-C.

In their study on 120 T2DM male patients, Singh G et al found high prevalence of hypercholesterolemia, hypertriglyceridemia and high LDL and low HDL which are well known risk factors for cardiovascular diseases.[13] Goldberg reported that the cause of dyslipidaemia in type 2 diabetes mellitus may be that insulin is not working properly which affects the liver apolipoprotein production. The apolipoprotein regulates the enzymatic activity of lipoprotein lipase (LpL) and Cholesterol ester transport protein.[14] Erciyas et al also reported positive correlation of HbA1c level with TC and TG in diabetic patients.[15] The Diabetes complications and control trial (DCCT) established HbA1c as the gold standard of glycemic control. The level of HbA1c value <7.0% was said to be appropriate for reducing the risk of cardiovascular complications. The diabetic patients with higher HbA1c value (value ≥ 7.0%) can exhibit a significant increase in TC, LDL, TG and HDL in comparison to patients with HbA1c value <7.0%.[16] Khan et al also reported that severity of dyslipidaemia increases in patients with higher HbA1c value.[17] As elevated HbA1c and dyslipidaemia are independent risk factors of CVD, diabetic patients with