

Original Research Article

Evaluation of type-2 diabetes mellitus patients for dyslipidemia in a tertiary care centre

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ABSTRACT

Background: Diabetes mellitus (DM) is a syndrome consisting of metabolic, vascular and neuropathic components that are interrelated. Diabetes mellitus is associated with a considerably increased risk of premature atherosclerosis, particularly coronary heart disease (CHD) and peripheral arterial disease. Dyslipidemia is a common feature of diabetes. There is an association between atherosclerotic cardiovascular disease and serum cholesterol and triglyceride levels in both type 1 and type 2 diabetes.

Methods: The study was done on 50 adult diabetes mellitus (T2) patients from IPD of General Medicine wards at SMS Hospital, Ahmedabad, Gujarat. 50 healthy age and sex matched healthy volunteers were taken as control. They were evaluated for lipid profile i.e., Total Cholesterol (TC), Triglyceride (TG), Low-density lipoprotein (LDL), High density lipoprotein (HDL), Very low density lipoprotein (VLDL) and glycemic status i.e., Fasting blood glucose (FBS), Postprandial 2 hours blood glucose (PP2BS) & Glycosylated haemoglobin (HbA1c).

Results: Diabetic cases had statistically highly significant ($p < 0.001$) elevated levels of total Cholesterol, Triglycerides and VLDL as compared to controls. Serum TG, serum TC, LDL-C and VLDL-C had positive correlation with the postprandial plasma glucose, fasting plasma glucose and HbA1c.

Conclusions: Significant correlations between HbA1c levels and lipid levels point towards the usefulness of HbA1c for screening high-risk diabetic patients. High TC, TG, LDL-C and HbA1c with normal or low HDL-C is seen in almost all diabetic patients either alone or in combinations.

Keywords: Coronary heart disease, Dyslipidemia, HbA1c, High density lipoprotein

INTRODUCTION

Diabetes mellitus (DM) is a syndrome consisting of metabolic, vascular and neuropathic components that are interrelated. It is defined as group of metabolic disorder that is characterized by hyperglycemia resulting from defect in insulin secretion, insulin action or both. The lack of effective insulin action leads to alteration in carbohydrate, fat and protein metabolism.¹ Diabetes mellitus (DM) is a hereditary, chronic endocrine metabolic disorder. India, a developing Asian country

with fast industrialization and a modern lifestyle is facing a grave problem in having the largest number of people with diabetes, which is estimated to reach 80 million by the year 2030.²⁻⁵

A characteristic pattern, termed dyslipidemia, consists of increased total cholesterol (TC), triglycerides (TG), low density lipoprotein (LDL) and very low density lipoprotein (VLDL) cholesterol and decreased high density lipoprotein (HDL). This pattern is most frequently seen in diabetics and may be a preventable

and/or regressive risk factor for subsequent cardiovascular disease.

Diabetes is associated with an increased cholesterol synthesis, may be due to the increased activity of HMG CoA reductase, but HDL cholesterol levels are low.^{6,7} Patients with Diabetes mellitus are at greater risk of developing vascular diseases because of lipid abnormalities. Lipid abnormalities and insulin use is critically discussed in diabetics.⁸

Dyslipidaemia is a result of abnormalities in the plasma lipids. These abnormalities may be due to elevated total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG) and reduced high-density lipoprotein cholesterol (HDL-C) levels, occurring alone or in combinations.⁹ The burden of dyslipidaemia is gigantic in terms of morbidity, mortality and medical costs.¹⁰ Dyslipidaemia is a well-known major modifiable risk factor for IHD, as elevated levels of TG, TC, LDL-C and low levels of HDL-C are documented risk factors for atherogenesis.¹¹ Increased prevalence of dyslipidaemia was detected also among adolescents and young adults which lead to increasing the prevalence of CAD later on life.¹² It is reported that a cholesterol level determined at age 22 predicts the higher rate of CAD development over 30 to 40 years. Moreover, nearly half of young adults with high TC have 5 times the risk of CAD and 9 times the risk of MI (myocardial infarction) in comparison with those having low TC levels over the following 30 to 40 years.¹³ Primary dyslipidemia is due to genetic defect in metabolism of lipoproteins and secondary dyslipidemia is due to underlying cause which influences circulating levels of lipids. Lipid triad- high triglyceride, low HDL-C, high LDL-C is the most common established risk factor for cardiovascular disease. Risk increases when accompanied by diabetes and hypertension.

Dyslipidemia is defined by National Cholesterol Education Programme as (NCEP) follows:

- TG \geq 150mg/dl
- TC \geq 200mg/dl
- LDL-C \geq 130 mg/dl
- HDL-C $<$ 40 mg/dl^{14,15}

HDL-C levels are independent, strong inverse predictor of coronary heart diseases and acts as an anti atherogenic and the mechanism by which HDL-C protects CAD is removal of cholesterol from peripheral tissues to liver and excretion in bile.¹⁶ Aims and objectives of the study was to determine the lipid profile of the patients with type 2 DM and to determine the prevalence of dyslipidemia in patients of type 2 DM.

METHODS

It is a cross-sectional observational study. The study was conducted on 50 adult diabetes mellitus (T2) patients from IPD of General Medicine wards at SMS Hospital,

Ahmedabad, 50 healthy age and sex matched healthy volunteers were taken as control.

Inclusion criteria

- $>$ 18 years of age healthy volunteer
- Not any known acute or chronic illness

Randomly selected age and sex matched individuals, with no history of diabetes or any type of illness and not on statins were used as controls.

Exclusion criteria

- Age less than 18 year
- Who are in ICU and critically ill
- Gestational DM
- Drug induced DM (e.g. steroids)
- Patients on lipid lowering agents (e.g. statins)

Method of examination

Fasting venous blood was withdrawn and analysed for lipid profile (TC, TG, LDL-C, HDL-C & VLDL-C) in diabetic and control persons. Their glycemic status (FBS, PP2BS, HbA1C) was assessed. TC, TG, HDL was measured by spectrophotometry on Roche Cobas 6000. While LDL was measured by calculation,

$$\text{LDL} = \text{TC} - (\text{VLDL} + \text{HDL})$$

VLDL was measured by calculation,

$$\text{VLDL} = \text{Triglyceride}/5.$$

FBS and PP2BS was measured by spectrophotometry and HbA1C was measured by turbidimetry on Roche Cobas 6000.

Statistical analysis

The quantitative data was represented as their mean \pm SD. Categorical and nominal data was expressed in percentage. The t-test was used for analysing quantitative data, or else non parametric data was analyzed by Mann Whitney test and categorical data was analyzed by using chi-square test. Pearson's correlation coefficient was used to determine the correlation between parameters. The significance threshold of p-value was set at <0.05 . All analysis was carried out by using SPSS software version 20.

RESULTS

Table 1 shows that 42 cases and 42 controls were in age group of 45 to 74 years while, 8 cases and 8 controls were in age group of 18 to 44 years.

The mean age of cases was 55.28 ± 11.85 years ranging from 18 to 74 years, while mean age of controls was 54.72 ± 12.33 years in ranging from 18 to 74 years.

Table 1: Age distribution of cases and controls.

Age group (years)	Cases		Controls	
	No.	%	No.	%
18-24	1	2.00%	1	2.00%
25-34	3	6.00%	3	6.00%
35-44	4	8.00%	4	8.00%
45-54	15	30.00%	17	34.00%
55-64	15	30.00%	16	32.00%
65-74	12	24.00%	9	18.00%
Total	50	100.00%	50	100.00%
Mean±SD	55.28±11.85		54.72±12.33	
Range	18 - 74 years		18-74 years	

p>0.05 (NS)

Table 2 shows that mean HbA1C level in case group was 9.55±2.10% and in control group was 5.49±0.44%.

Table 2: HbA1C distribution among cases and controls.

HbA1C	Cases		Controls	
	No.	%	No.	%
<6.5 %	1	2.00%	50	100.00%
≥6.5 %	49	98.00%	0	00.00%
Total	50	100.00%	50	100.00%
Mean±SD	9.55±2.10		5.49±0.44	

p<0.001 (HS)

Table 3: Blood parameters in cases and controls.

	Cases		Controls		p value
	Range	Mean±SD	Range	Mean±SD	
RBS (mg/dL)	101-442	210.58±66.30	62-142	109.90±28.23	<0.001 (HS)
FBS (mg/dL)	128-340	165.84±39.72	68-114	97.20±21.09	<0.001 (HS)
PP2BS (mg/dL)	176-470	255.56±57.69	90-162	126.88±31.14	<0.001 (HS)
HBA1C (%)	5.4-15.8	9.55±2.10	4.6-6.2	5.85±1.35	<0.001 (HS)

Table 4: HbA1C distribution among cases and controls.

Lipids (mg/dL)	Cases		Controls		p value
	No.	%	No.	%	
High TC (≥200)	37	74%	9	18%	<0.001 (HS)
High TG (≥150)	45	90%	10	20%	<0.001 (HS)
High LDL-C (≥130)	15	30%	8	16%	>0.05 (NS)
Low HDL-C (<40)	21	42%	23	46%	>0.05 (NS)
High VLDL-C (≥30)	44	88%	19	38%	<0.01 (S)

Table 5: Pearson's correlation of lipid profile with fasting plasma glucose, postprandial plasma glucose and HbA1c in cases.

mg/dL	FBS		PPBS		HbA1C %	
	r	p	r	p	r	p
Serum TC	0.462	<0.001	0.490	<0.001	0.478	<0.001
Serum TG	0.415	<0.001	0.528	<0.001	0.463	<0.001
Serum LDL-C	0.305	<0.001	0.267	<0.001	0.296	<0.001
Serum HDL-C	0.085	>0.05	0.078	>0.05	0.086	>0.05
Serum VLDL-C	0.385	<0.001	0.491	<0.001	0.431	<0.001

Table 3 shows that mean RBS levels in cases was 210.58±66.30 mg/dL ranging from 101 to 442 mg/dL and in controls was 109.90±28.23 mg/dL ranging from 62 to 142 mg/dL. Mean FBS levels in cases was 165.84±39.72 mg/dL ranging from 128 to 340 mg/dL and in controls was 97.20±21.09 mg/dL ranging from 68 to 114 mg/dL and mean PP2BS levels in cases was 255.56±57.69 mg/dL ranging from 176 to 470 mg/dL and in controls

was 126.88 ±31.14 mg/dL ranging from 90 to 162 mg/dL. Mean HbA1c level in cases was 9.55±2.10% ranging from 5.4 to 15.8% and in controls was 5.85±1.35% ranging from 4.6 to 6.2%.

Table 4 shows, high TC(>200 mg/dL) in 37 (74%), high TG(>150 mg/dL) in 45 (90%), high LDL-C (>130 mg/dL) in 15(30%), Low HDL-C (<40 mg/dL) in

21(42%) and high VLDL-C (≥ 30) in 44 (88%) cases, while in control high TC (>200 mg/dL) in 9(18%), high TG (>150 mg/dL) in 10 (20%), high LDL-C (>130 mg/dL) in 8(16%), Low HDL-C (<40 mg/dL) in 23 (46%) and high VLDL-C(≥ 30) in 19 (38%) subjects.

Table 5 shows, Serum TG, TC, LDL-C, VLDL-C and HDL-C had positive correlation with the postprandial plasma glucose, fasting plasma glucose and HbA1c. Postprandial plasma glucose had stronger correlation with serum triglyceride.

DISCUSSION

Total 100 subjects were recruited for the study consisted of 50 diabetics (cases) and 50 healthy controls.

Of the 50 diabetic patients equal number of males (25) and females (25) were recruited. Majority (84%) of the diabetic patients were aged 45-74 years that proves that age plays a significant role in the risk of developing type 2 DM especially after 40yrs.¹⁷ Type 2 diabetes begins typically in middle life or later, the prevalence rises with age. This is consistent with studies published by WHO (1998).¹⁸ This also implies that impact of age as a risk factor of diabetes cannot be overemphasized as this trend has been demonstrated in most study populations around the world.¹⁹

Almost all the patients in case group had high FBS 165.84 ± 39.72 mg/dL, high PP2BS 255.56 ± 57.69 mg/dL and high RBS 210.58 ± 66.30 mg/dL. Also had high HbA1c level $9.55 \pm 2.10\%$ in cases, only one female had HbA1C level $<6.5\%$.

The results showed that the lipids (TC, TG, LDL-C, VLDL-C) of the diabetics were higher than that of the controls and is similar as shown by Masum et al, and Huang et al.^{20,21} The absolute LDL-C concentration in present study is not altered significantly, as it does not directly reflect the increased TG and VLDL-C levels.²²

Our study shows high TC in 74%, high TG in 90%, high LDL-C in 30% and Low HDL-C in 42% in diabetic cases, while most dyslipidemic combination was high TC and high TG 72% cases. A little different from our observation Agarwal et al, showed high TC in 34%, high TG in 56%, high LDL-C in 22% and Low HDL-C in 52% diabetic cases, while most common dyslipidemic combination was high TG and low HDL-C, which indicate that the diabetics due to dyslipidemia are prone in future for developing cardiovascular, cerebrovascular complications and malignancies, like prostate, colorectal, and breast.²³⁻²⁷ Although, levels of HDL-C in diabetic individuals are reportedly comparable with that found in non-diabetics, low levels of HDL-C along with elevated TG have been reported in T2 DM patients as probable cause of CVD. This study showed that T2 DM

influence abnormal lipid profile in diabetics when compared with controls.²³ Agarwal et al, observed high TC, TG, LDL-C and low HDL-C, while authors observation showed high TC, TG, LDL-C with statistically insignificant low HDL-C.²³

Similar to authors observations Singh D et al, Bhatt R et al, Alam R et al, Lodha R et al, Bali K et al, also observed High TC, High TG, High LDL-C, High VLDL-C, low HDL-C in diabetics as compared to controls.²⁸⁻³² But HDL-C was statistically insignificant in our cases when compared with controls.

The Diabetes complications and control trial (DCCT) established HbA1c as the gold standard of glycemic control. The level of HbA1c value $\leq 6.5\%$ was said to be appropriate for reducing the risk of cardiovascular complications (Rohlfing et al).³³ Diabetic patients were divided into 2 groups as per the HbA1c cutoff of 6.5%. The diabetic patients with HbA1c value $> 6.5\%$ exhibited a significant increase in TC, LDL-C, TG, VLDL-C with near normal HDL-C in comparison with HbA1c value $\leq 6.5\%$ in controls.

Correlation studies within the lipid groups also showed interesting results. As cholesterol increased, it was accompanied with increase in triglyceride, LDL while HDL decreased. These results stress the need for control of plasma cholesterol and triglyceride levels in order to lower LDL levels and elevate HDL levels. These two parameters -Low LDL and high HDL are protective against CHD. This shows that the lipids are closely correlated with each other and control of one influences the others. This is in agreement with the reports of (El-Hazmy and Warsy and Hague).^{34,35} That long-standing hyperglycemia rather than blood glucose level is broadly related to the diabetic complications seen in the diabetics. Similar findings were observed by Agarwal et al, and Lemya et al.^{23,36}

CONCLUSION

From this study it can be concluded that DMT2 is a disease mainly of middle age persons affecting both sexes. High TC, TG, LDL-C and HbA1c with normal or low HDL-C is seen in almost all diabetic patients either alone or in combinations. HDL-C was normal or low in 56% of male and 28% of female diabetics studied, but insignificant as compared to controls. High blood glucose or poorly controlled diabetics had more dyslipidemia.

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REFERENCES

- Imani SF, Hashemipour M, Kelishadi R. lipid profile of children with type in diabetes compared to controls. *ARYA J.* 2006;2(1):36-8.
- King H, Aubert RE, Herman WH. Global burden of diabetes, 1995–2025: prevalence, numerical estimates, and projections. *Diab Care.* 1998 Sep 1;21(9):1414-31.
- Fall CH. Non-industrialised countries and affluence: relationship with type 2 diabetes. *Brit Med Bull.* 2001 Nov 1;60(1):33-50.
- Bjork S, Kapur A, King H, Nair J, Ramachandran A. Global policy: aspects of diabetes in India. *Health policy.* 2003 Oct 1;66(1):61-72.
- Rao CR, Kamath VG, Shetty A, Kamath A. A study on the prevalence of type 2 diabetes in coastal Karnataka. *Int J Diabetes Dev Ctries.* 2010;30(2):80-5.
- Adler AI, Neil HA, Stratton IM, Holman RR. Ethnicity and cardiovascular disease: The incidence of myocardial infarction in white, South Asian, and Afro-Caribbean patients with type 2 diabetes (UK Prospective Diabetes Study 32). *Diab Care.* 1998 Aug 1;21(8):1271-7.
- Kudchodkar BJ, Lee MJ, Lee SM, DiMarco NM, Lacko AG. Effect of dietary protein on cholesterol homeostasis in diabetic rats. *J Lipid Res.* 1988 Oct 1;29(10):1272-87.
- Mitka M. Aggressive lipid, hypertension targeting yields no benefit for some with diabetes. *JAMA.* 2010 May 5;303(17):1681-3.
- Bamba V, Rader DJ. Obesity and atherogenic dyslipidemia. *Gastroenterol.* 2007 May 1;132(6):2181-90.
- Smith DG. Epidemiology of dyslipidemia and economic burden on the healthcare system. *Am J Managed Care.* 2007 Jun;13:S68-71.
- Berenson GS, Srinivasan SR, Bao W, Newman WP, Tracy RE, Wattigney WA. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. *N Engl J Med.* 1998 Jun 4;338(23):1650-6.
- Joshi SR, Anjana RM, Deepa M, Pradeepa R, Bhansali A, Dhandania VK, et al. Prevalence of dyslipidemia in urban and rural India: the ICMR–INDIAB study. *PloS One.* 2014;9(5).
- Washington RL. Interventions to reduce cardiovascular risk factors in children and adolescents. *Am Fam Phys.* 1999 Apr 15;59(8):2211-8.
- Grundy S. Third Report of the National Cholesterol Education Program (NCEP), National Heart, Lung, and Blood Institute. NIH Publication; 2001:3670.
- Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J. Harrison's principles of internal medicine. Longo DL, editor. New York: Mcgraw-hill; 2012.
- Rye KA, Bursill CA, Lambert G, Tabet F, Barter PJ. The metabolism and anti-atherogenic properties of HDL. *J Lipid Res.* 2009 Apr 1;50(Supplement):S195-200.
- Tagoe DN, Amo-Kodieh P. Type 2 diabetes mellitus influences lipid profile of diabetic patients. *Ann Biol Res.* 2013;4(6):88-92.
- Alberti KG, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus. Provisional report of a WHO consultation. *Diab Med.* 1998 Jul;15(7):539-53.
- VinodMahato R, Gyawali P, Raut PP, Regmi P, Singh KP, Pandeya DR, Gyawali P. Association between glycaemic control and serum lipid profile in type 2 diabetic patients: Glycated haemoglobin as a dual biomarker. *Biomed Res.* 2011;22(3):375-80.
- Masum N, Nasrin F, Neaz S, Tamanna N, Islam KS, Chowdhury MR, et al. Association of Uric acid with type II diabetes. *IRJALS.* 2012;1(4):32- 7.
- Huang KC, Chen CC, Su YC, Lin JS, Chang CT, Wang TY, et al. The relationship between stasis-stagnation constitution and peripheral arterial disease in patients with type 2 diabetes. *Evidence-Based Complement Alternat Med.* 2014;2014.
- Gustafsson I, Brendorp B, Seibæk M, Burchardt H, Hildebrandt P, Køber L, et al. Influence of diabetes and diabetes-gender interaction on the risk of death in patients hospitalized with congestive heart failure. *J Am Coll Cardiol.* 2004 Mar 3;43(5):771-7.
- Agrawal Y, Goyal V, Chugh K, Shanker V, Singh AA. Types of dyslipidemia in type 2 diabetic patients of Haryana region. *Sch J App Med Sci.* 2014;2(4):1385-92.
- Yang X, So W, Ko GT, Ma RC, Kong AP, Chow CC, et al. Independent associations between low-density lipoprotein cholesterol and cancer among patients with type 2 diabetes mellitus. *CMAJ.* 2008 Aug 26;179(5):427-37.
- Jee SH, Ohrr H, Sull JW, Yun JE, Ji M, Samet JM. Fasting serum glucose level and cancer risk in Korean men and women. *JAMA.* 2005;293(2):194-202.
- Lipscombe L, Goodwin P, Zinman B, McLaughlin JR, Hux JE. Diabetes mellitus and breast cancer: a retrospective population-based cohort study. *Breast Cancer Res Treat.* 2006;98(3):349-56.
- Rodriguez C, Patel AV, Mondul AM, Jacobs EJ, Thun MJ, Calle EE. Diabetes and risk of prostate cancer in a prospective cohort of US men. *Am J Epidemiol.* 2005;161(2):147-52.
- Singh D, Singh A, Kumar R, Khan I. Dyslipidemia in Type 2 Diabetes Mellitus Patients of Udaipur Population. *Scholars J Appl Med Sci.* 2015;3(2D):813-5.
- Bhatt RD, Lochan K. Types of Dyslipidemia in Type 2 DM Patients of Bhubaneswar region. *Ann Clini Chem Lab Med.* 2015 Mar 19;1(1):33-6.

30. Alam R, Aleem M, Khan S, Waseem SM. Assessment of Lipid profile and Glycated Hemoglobin in Newly Diagnosed type 2 Diabetes Mellitus in Rural Population of Indore, MP, India. *Sch J App Med Sci*. 2015;3(2E):916-8.
31. Lodha R, Lal R, Biyani S. HbA1c as screening biomarker of dyslipidemia in type 2 diabetes mellitus patients. *Scholar J Appl Med Sci*. 2016;4:1600-2.
32. Bali K, Vij AS. Pattern of dyslipidemia in Type 2 Diabetes Mellitus in Punjab. *Int J Res Med Sci*. 2016;4(3):809-12.
33. Rohlfing CL, Wiedmeyer HM, Little RR, England JD, Tennill A, Goldstein DE. Defining the relationship between plasma glucose and HbA1c: analysis of glucose profiles and HbA1c in the Diabetes Control and Complications Trial. *Diab Care*. 2002 Feb 1;25(2):275-8.
34. El-Hazmy MAF, Warsy A S. Lipid profile in Saudi NIDDM patients. *Int Diabetes Digest*. 1994;5:21-4.
35. Hague S. The role of ACE inhibitors in diabetic nephropathy. *Int Diabetes Digest*. 1994;5:21-4.
36. Naway LM. Lipid Profile in Sudanese Diabetic Patients. 2011:48-54.

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