

A comparative study of lipid profile in normotensive diabetes mellitus type 2 and hypertensive diabetes mellitus type 2

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Abstract

Background: This cross sectional study was conducted during the period of December 2008 to June 2010. 48 Patient of normotensive diabetes mellitus type 2 (28 males and 20 females) and 47 patient of hypertensive diabetes mellitus type 2 (25 males and 22 females) presented to Kamalnayan Bajaj Hospital were included in study. 54 healthy control population (28 males and 26 females) were selected from hospital employee, staff and candidate from routine health check up. **Objective of Study:** Objective of study was to compare lipid profile in normotensive diabetes mellitus type 2 and hypertensive diabetes mellitus type 2. **Methods:** A hospital based cross sectional study was undertaken. A detailed clinical examination of patient and control was done. All patient and controls were investigated and record was noted. Control population was compared with normotensive diabetic patients using unpaired t-test. Control population was compared with hypertensive diabetic patients using unpaired t-test. Normotensive diabetic patients were compared with hypertensive diabetic patients using unpaired t-test. P value of <0.05 was considered statistically significant to compare lipid profiles. **Results:** Most of the results are statistically significant and here we discuss about it. **Keywords:** dyslipidemia, hypertention, Diabetes Mellitus.

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INTRODUCTION

Lipoproteins are complexes of lipids and proteins that are essential for the transport of cholesterol, triglycerides and fat soluble vitamins. Abnormalities in plasma lipoprotein and derangement in lipid metabolism rank among the most firmly established and best understood risk factors for atherosclerosis.¹ Number of people with type 2 diabetes mellitus has risen sharply in recent years and has reached epidemic proportion, particularly in developing countries like India. Indeed, India with 40 million people with diabetes leads the world with a maximum number than any other country and this number is said to increase to 70 million by the year 2025.² Type 2 diabetes mellitus

is well known to be associated with increased risk of microvascular complications such as nephropathy, retinopathy and neuropathy as well as macrovascular complications such as coronary artery disease, peripheral arterial disease and stroke.³⁻⁵ Lipoprotein abnormalities are common in diabetes and contribute significantly to its complication. Lipid abnormalities play an important role in the causation of diabetic atherosclerosis,^{6, 7} but the pathophysiology is complex and involves insulin resistance and hyper insulinemia⁸⁻¹⁰ and hyperglycemia¹¹⁻¹⁴ explaining the increased susceptibility of patients with diabetes to atherosclerotic complications. The most common pattern of dyslipidemia in type 2 diabetic patients is elevated triglyceride level and decreased HDL cholesterol level. The concentration of LDL cholesterol is usually not significantly different from non diabetic individuals.¹⁵ Type 2 diabetes mellitus and hypertension frequently co-exist together. Whereas hypertension is present in 24% of adults in general population, it is present in 75% of adults with diabetes mellitus. Hypertension exaggerates atherosclerotic cardiovascular disease in diabetes and increases the risk of complications. Therefore, JNC 7 guidelines had recommended a usual blood pressure of 140/90 mmHg as the threshold for initiating anti-hypertensive medication

in most patients, with a lower threshold of 130/80mmHg for high risk patients with diabetes mellitus.¹⁶ Type 2 diabetes mellitus, hypertension and dyslipidemia frequently occur together and in association with insulin resistance. 3 The Recognition that cardiovascular risk factor tends to cluster within individual has important implication for evaluation and treatment which should address overall risk and not simply focus on hypertension or diabetes alone.¹⁷ We compared the plasma lipid level among age and sex matched normotensive diabetic patient and hypertensive diabetic patient to healthy age and sex matched controls.

MATERIAL AND METHODS

Study Type: Cross sectional study.

Study Period: From December 2008 to June 2010

Sample Size: 48 patient of normotensive diabetes mellitus type 2 (28 male and 20 female) and 47 patient of hypertensive diabetes mellitus type 2 (25 male and 22 female) presented to Kamalnayan Bajaj Hospital, Aurangabad from Dec 2008 to June 2010. 54 healthy control populations (28 male and 26 female) were selected from hospital employee, staff and candidates from routine health check-up.

Inclusion Criteria

1. Patient willing to participate in study.
2. All patient of normotensive diabetes mellitus type II and hypertensive diabetes mellitus type II. Presenting to KNBH as OPD+IPD basis.
3. All patient of diabetes mellitus of Age > 30 years to avoid inclusion of pt of type I diabetes mellitus.
4. All patient of normotensive diabetes mellitus on oral hypoglycemic agent / insulin therapy 29
5. All patients of hypertensive diabetes mellitus on oral hypoglycemic agent / Insulin therapy / antihypertensive medication.

Exclusion Criteria

1. Patient not willing to participate in study.
2. Patient of less than 30 years and more than 70 years of age.
3. Patient of Gestational diabetes.
4. Patient of Pregnancy induced hypertension /preeclampsia / eclampsia.
5. Patient of medical renal disorder.
6. Patient of Hypothyroidism/ Hyperthyroidism
7. Patient on lipid lowering drugs Patient was included as diabetes mellitus type II if age > 30 yr and < 70 yrs.
8. BSL – fasting > 126 mg% or
9. BSL –post glucose (after 2 hr) >200 mg% or
10. Patient on oral hypoglycemic agent/insulin.³⁰

Patient was considered normotensive if systolic BP is < 130 mmHg or diastolic BP <80 mmHg in sitting right arm position and not on any antihypertensive medication in past or present. Patient was considered as hypertensive if systolic BP is > 130 mmHg or diastolic BP is > 80 mmHg in sitting right arm supine position or on antihypertensive medication.

All normotensive diabetes mellitus type II and hypertensive diabetes mellitus type II patient as per criteria mentioned above were included in study irrespective of previous lipid profile status All patients were evaluated as per proforma. Detail history of presenting complaints/past medical history/drug history/family history/personal history/general examination including body weight, height, body mass index waist circumference, detail systemic examination were done and recorded. All patients were evaluated with blood sugar fasting and 2 hr post glucose/lipid profile/ routine urinalysis and microscopy/blood urea /serum creatinine/haemogram/ECG.³¹ Blood sample for lipid profile was drawn after 12hrs fasting state. Lipid profile was done on a fully automated dimension clinical chemistry system of Siemens machine. Automated LDL cholesterol assay was a homogenous method for directly measuring LDL-C level in human serum or plasma, without the need for any off line pretreatment of centrifugation steps. Triglyceride method was based on an enzymatic procedure in which a combination of enzymes was employed for measurement of serum or plasma triglyceride. Cholesterol method was based on an enzymatic procedure in which a combination of enzymes was employed for measurement of serum or plasma cholesterol. Automated HDL assays measure HDL cholesterol levels directly without the need for sample pretreatment or sample treatment or specialized centrifugation steps using a two reagent format. Serum electrolyte/ serum uric acid /stress test/2 Decho/ angiography and other hematological/ biochemical /radiological investigation were done as per indication and record was kept.³² All patients fulfilling above mentioned criteria after detailed informed consent were considered to participate in study and will be evaluated as per proforma.

OBSERVATION AND RESULT

Total 95 patients and 54 controls were included in the study. Out of 95 patients, 53 were males and 42 were females. Out of 54 controls, 28 were males and 26 were females Out of 53 male patients, 28 were normotensive diabetic males and 25 were hypertensive diabetic males. Out of 42 female patients, 20 were normotensive diabetic and 22 were hypertensive diabetic. Out of 54 control population, 28 were control male and 26 were control

female. Mean age of normotensive diabetic males was 50.82 + 9.80 yrs. Mean age of hypertensive diabetic males was 53.08 + 7.44 yrs. Mean age of normotensive diabetic females was 46.3 + 7.46 yrs. Mean age of hypertensive diabetic females was 52.90 + 8.29 yrs. Mean age of control males was 51.50 + 10.23 yrs. Mean age of control females was 52.26 + 11.31 yrs. Mean duration of diabetes in normotensive diabetic males was 5.85 years. Mean duration of diabetes in hypertensive diabetic males was 6 years. Mean duration of diabetes in normotensive diabetic females was 6.1 years.

Mean duration of diabetes in hypertensive diabetic females was 7.9 years.

Normotensive Diabetic Males 5.85

Hypertensive Diabetic Males 6

Normotensive Diabetic Females 6.1

Hypertensive Diabetic Females 7.9

39 Mean LDL-C in normotensive diabetic males and hypertensive diabetic males were 105.14 + 23.89 and 107.72 + 26.22 respectively, which were significantly higher as compared to normal control males i.e. 94.85 + 9.73 [p=0.000012 and p=0.002589 respectively] Though mean LDL-C was higher in hypertensive diabetic males than normotensive diabetic males, it was not statistically significant [p=0.57]. 40 Mean Triglyceride in normotensive diabetic males and hypertensive diabetic males were 162.5 + 63.70 and 148.92 + 80.61 respectively, which were significantly higher as compared to normal control males i.e. 106.32 + 22.48 [p=0.0000061 and p < 0.0000001 respectively]. Though mean triglycerides was higher in normotensive diabetic males than hypertensive diabetic males, it was not statistically significant [p=0.2368]. Mean HDL-C in normotensive diabetic males and hypertensive diabetic males were 38.42+8.25 mg/dl and 37.52 + 8 mg/dl which were significantly lower as compared to control males i.e. 45.61 + 5.31 mg/dl [p=0.02551 and p=0.04 respectively]. Though mean HDL-C in normotensive diabetic males were higher than hypertensive diabetic males, it was not statistically significant [p=0.8842]. Mean total cholesterol in normotensive diabetic males and hypertensive diabetic males were 176.00+34.85 and 168.04 + 33.03 respectively, which were significantly higher as compared to control males viz.147.49+13.30 [p=0.00001432 and p=0.00003853 respectively]. Though mean total cholesterol in normotensive diabetic males were higher than hypertensive diabetic males, it was not statistically significant [p=0.7952]. Mean LDL-C in normotensive diabetic females and hypertensive diabetic females were 101.9 + 25.27 and 103.36 + 26.09 respectively, which were significantly higher as compared to normal control females i.e. 96.07+ 6.78 [p < 0.0000001 and p < 0.0000001 respectively]. Though mean LDL-C in

hypertensive diabetic females was higher than normotensive diabetic females, it was not statistically significant [p=0.8940]. Mean Triglyceride in normotensive diabetic females and hypertensive diabetic females were 151.95+ 69.94 and 148.27+ 77.99 respectively, which were significantly higher as compared to normal control females i.e. 105.26+ 21.73 [p=0.00000027 and p < 0.0000001 respectively]. Though mean triglyceride in normotensive diabetic females was higher than hypertensive diabetic females, it was not statistically significant [p=0.6371]. Mean HDL-C in normotensive diabetic females and hypertensive diabetic females were 39.25+ 7.26 and 40.31+ 9.20 respectively, which were significantly lower as compared to normal control females i.e. 45.92+ 4.68 [p=0.0016 and p=0.04 respectively]. Mean Total Cholesterol in normotensive diabetic females and hypertensive diabetic females were 161.65+ 37.07 and 160.40 + 34.41 respectively, which were significantly higher as compared to normal control females i.e. 147.42 + 13.99 [p=0.003853 and p=0.001247 respectively]. Though mean total cholesterol in normotensive diabetic females was higher than hypertensive diabetic females, it was not statistically significant [p=0.7361]. As per American Diabetic Association (ADA) guidelines 201043, LDL <100mg/dl, HDL>50mg/dl for females, HDL>40mg/dl for males and Triglycerides <150mg/dl were considered as low risk lipid values. In our study, out of 53 male patients, 28 were normotensive diabetic and 25 were hypertensive diabetic. 57.14% of normotensive diabetic males and 60% of hypertensive diabetic males had LDL >100mg/dl. 42.85% of normotensive diabetic males and 40% of hypertensive diabetic males had triglyceride value >150mg/dl. 57.14% of normotensive diabetic males and 68% of hypertensive diabetic males had HDL <40mg/dl.

DISCUSSION

Lipid profile abnormality contributes significantly in atherosclerosis and its complications. Dyslipidemia, diabetes mellitus and hypertension frequently co-exist together and in association with insulin resistance. The recognition that cardiovascular disease risk factors tends to cluster within individuals has important implication for evaluation and treatment which should address overall risk and not simply focus on hypertension or diabetes mellitus alone. Furthermore, large data supports the reduction in cardiovascular morbidity and mortality with lipid lowering agents. Evaluation and monitoring of lipid profile becomes an integral part in management of diabetic and hypertensive patients. Though increased triglycerides and low HDL-C is most common pattern of dyslipidemia, exact pattern of dyslipidemia in hypertensive diabetic patients is not well defined. We

compared plasma lipid level among age and sex matched type 2 diabetes mellitus and concurrent type 2 diabetes mellitus with hypertension to healthy age and sex matched controls.

LDL-Cholesterol

The role of LDL-C in atherogenesis is most important. The first step in atherogenesis is accumulation and bonding of LDL-C with proteoglycan of intima of vessel wall²⁵. LDL-C molecules bound to 50 proteoglycan have increased susceptibility to oxidative modification²⁶. Constituents of oxidatively modified LDL-C augments the expressions of leukocyte adhesion molecules [VCAM-1 and ICAM-1] on vascular endothelium and also stimulates production of chemokines by vascular endothelium which causes direct migration of leukocyte into intima of vessel wall^{27,28}. Once recruited to arterial intima the inflammatory cells, macrophages and T-lymphocytes start to uptake oxidized LDL-C through special type of scavenger receptor and become lipid laden foam cell²⁹. These lipid laden foam cells in the intima of vessel wall begin to replicate under the influence of macrophage- colony stimulating factor resulting in formation of fatty streak, the initial lesion of atherosclerosis. Thus oxidized LDL-C and their uptake by inflammatory cells through scavenger receptor is most firmly established event in initial stages of atherosclerosis. Due to its important role in atherosclerosis LDL cholesterol is used as a marker for starting lipid lowering agents and included in ADA guideline 2010. Mean LDL – C of normotensive diabetic and hypertensive diabetic patient was 148.1 + 34.41 mg/dl and 158.93 + 34.41, which was significantly higher as compared to control group i.e. 80.04 + 38.67 mg/dl (p=0.0001) in a study by Idogun ES *et al.*⁴⁷ 51 Mean LDL–C of normotensive diabetic female and normotensive diabetic male was 141.23 + 43 and 116.1+ 40.96(p<0.05) in a study by M. Nakhjavani *et al.*⁴⁹ In a study by Lorenzo Gorden *et al*⁵⁰ mean LDL–C value in normotensive diabetic male and hypertensive diabetic male was 111.75 + 40.21 mg/dl and 131.96 + 38.97 mg/dl respectively and mean LDL–C value in normotensive diabetic female and hypertensive diabetic female was 140.75 + 51.87 mg/dl and 129.93 + 45.24 mg/dl respectively. In our study, mean LDL – C value in normotensive diabetic males and hypertensive diabetic males were 105.14 + 23.89 mg/dl and 107.72 + 26.22 mg/dl, which are significantly higher than control males i.e. 94.85 + 9.73 mg/dl (p=0.00012 and 0.00002589 respectively) (Table No.7). In our study, mean LDL – C value in normotensive diabetic female and hypertensive diabetic female were 101.9 + 25.97mg/dl and 103.66 + 26.09 mg/dl, which were significantly higher than control

females i.e. 96.07 + 6.78 mg/dl (p < 0.0000001 for each respectively)

Table 1: Distribution of male patient

Normotensive Diabetic Males	Hypertensive Diabetic Male
28	25

Table 2: Distribution of female patient

Normotensive Diabetic Females	Hypertensive Diabetic Male
20	22

Table 3: Distribution of controls

Control Males	Control Females
28	26

Table 4: Mean duration of diabetes (yrs)

	Mean Duration of Diabetes (yrs)
Normotensive Diabetic Males	5.85
Hypertensive Diabetic Males	6
Normotensive Diabetic Females	6.1
Hypertensive Diabetic Females	7.9

Table 5: Mean LDL-Cholesterol Level Male (mg/dl)

Age Group	Control Males	Normotensive Diabetic Males	Hypertensive Diabetic Males
30-39	89.4	117	117
40-49	95.25	80.75	98
50-59	92.1	119	112.88
60-69	98.17	106.66	110.6
Total Males	94.85	105.14	107.72

Table 6: Mean LDL Cholesterol Level-Female (mg/dl)

Age Group	Control	Normotensive Diabetic Females	Hypertensive Diabetic Females
30-39	94.4	101	100
40-49	92.4	97.5	110.5
50-59	96.87	110.5	133.5
60-69	98.62	94	118.2
Total Males	96.07	101.9	103.36

The values of LDL–C observed in normotensive diabetic and hypertensive diabetic population were higher as compared to 52 previous studies by Lorenzo Gorden *et al*⁵⁰, M. Nakhjavani *et al*⁴⁹ and Idogun ES⁴⁷ *et al.* Though mean LDL – C values were higher in hypertensive diabetic males than normotensive diabetic males, it was not statistically significant (p=0.57). Similarly, mean LDL – C values in hypertensive diabetic females were higher than normotensive diabetic females, this however was not statistically significant (p=0.8940).

HDL-Cholesterol

HDL-C carries oxidized cholesterol from blood vessels to liver through reverse cholesterol transport system.²² There is a strong inverse relation between HDL-C and cardiovascular risk. Indeed each increase of HDL-C by 1 mg/dl is associated with 2-3% decrease in risk of total cardiovascular disease. Hence HDL-C level > 40 mg/dl

for males and > 50 mg/dl for females is considered as a negative risk factor and incorporated in ADA guideline 2011.^{31,32} Mean HDL – C in normotensive diabetic was 33.25 + 6.57 mg/dl and hypertensive diabetic was 32.86 + 5.96 mg/dl in a study by Idogun ES *et al.*⁴⁷ 53 Mean HDL–C in normotensive diabetic male patients was 39.4 + 14.2 mg/dl and in normotensive diabetic female patients was 47.1 + 14 mg/dl in a study by M. Nakhjavani *et al.*⁴⁹ In a study by Lorenzo Gorden *et al.*⁵⁰, mean HDL – C in normotensive diabetic male and hypertensive diabetic males was 35.96 + 18.56 mg/dl and 34.77 + 6.56 mg/dl respectively and mean HDL – C in normotensive diabetic females and hypertensive diabetic females was 39.44 + 16 mg/dl and 41.76 + 18.56 mg/dl. Mean HDL – C in normotensive diabetic male patients was 59.33 + 3.48 mg/dl and in normotensive diabetic female patients was 58 + 3.48 mg/dl in a study by A Nyarko *et al.*⁴⁶. In our study, mean HDL – C in normotensive diabetic males and hypertensive diabetic males was 38.42 + 8.25 mg/dl and 37.52 + 8 mg/dl, which was significantly lower as compared to control males, where HDL – C is 45.61+ 5.31 mg/dl (p=0.02551 and 0.04 respectively)

Table 7: Mean HDL-Cholesterol- Male (mg/dl)

Age Group	Control	Normotensive Diabetic Males	Hypertensive Diabetic Males
30-39	43.6	43.5	38
40-49	42.75	37.5	38.5
50-59	45.2	36.6	34.66
60-69	41.67	39	41
Total Males	45.61	38.42	37.52

In our study, mean HDL – C in normotensive diabetic females and hypertensive diabetic females was 39.25 + 7.26 mg/dl and 40.31 + 9.20 mg/dl, which was significantly lower as compared to control females, where HDL – C was 45.92 + 4.68 mg/dl (p=0.0016 and 0.04 respectively)

Table 8: Mean HDL Cholesterol level-Female (mg/dl)

Age Group	Control	Normotensive Diabetic Females	Hypertensive Diabetic Females
30-39	43.2	39.5	40.5
40-49	47.8	34.5	35.5
50-59	46.5	41.25	42.25
60-69	42.37	39.75	40.75
Total Females	45.92	39.25	40.31

54 Mean HDL–C values of normotensive diabetic and hypertensive diabetic population observed in our study was approximately similar with the values mentioned by M. Nakhjavani *et al.*⁴⁹, Lorenzo Gorden *et al.*⁵⁰ and Idogun ES *et al.*⁴⁷ but higher values were observed by A Nyarko *et al.*⁴⁶. HDL–C was not significantly different in normotensive diabetic males and hypertensive diabetic

males (p=0.8842). Also, HDL – C was not significantly different in normotensive diabetic females and hypertensive diabetic females (p=0.30).

Triglyceride

Triglyceride levels tends to vary inversely with HDL-C as well as most humans are in post prandial state much of the day and triglyceride levels depends exclusively on diet. Fasting lipid profile may underestimate the actual quantitative and qualitative exposure of triglycerides on atherosclerosis. But triglycerides are considered as excellent marker of insulin resistance.^{33,34} In a study by Lorenzo Gorden *et al.*⁵⁰, mean TG in normotensive diabetic male and hypertensive diabetic male was 130.19 + 23.19 mg/dl and 131.96 + 38.97 mg/dl respectively and mean TG in normotensive diabetic females and hypertensive diabetic females was 147.02 + 166.51 mg/dl and 148.79 + 88.57 mg/dl. 55 Mean TG in normotensive diabetic was 192.19 + 38.08 mg/dl and hypertensive diabetic was 202.82 + 31.88 mg/dl in a study by Idogun ES *et al.*⁴⁷, which was higher as compared to controls i.e. 125.76 + 35.42 mg/dl and was statistically significant. In a study by M. Nakhjavani *et al.*⁴⁹ mean TG in normotensive diabetic male patients was 181 + 96 mg/dl and in normotensive diabetic female patients was 219.7 + 121 mg/dl (p<0.05). In our study, mean TG in normotensive diabetic males and hypertensive diabetic males was 162.5 + 63.7 mg/dl and 148.92 + 80.61 mg/dl, which was significantly higher as compared to control males, where TG is 106.32 + 22.48 mg/dl (p=0.00000061 and p < 0.0000001 respectively)

Table 9: Mean TG level-male (mg/dl)

Age group	Control	Normotensive Diabetic Males	Hypertensive Diabetic Males
30-39	92	173	88
40-49	95.25	164.25	166.33
50-59	111.8	151.8	155.33
60-69	128.5	171	125.5
Total Males	106.32	162.5	148.92

In our study, mean TG in normotensive diabetic females and hypertensive diabetic females was 151.95 + 69.94 mg/dl and 148.27 + 77.99 mg/dl, which was significantly higher as compared to control females, where TG was 105.26 + 21.73mg/dl (p=0.000000277 and p < 0.0000001 respectively)

Table 10: Mean TG Level-Female (mg/dl)

Age Group	Control	Normotensive Diabetic Females	Hypertensive Diabetic Females
30-39	101	153	148
40-49	99.8	145.5	141
50-59	105.5	148.5	128
60-69	111.12	170	171
Total Females	105.26	151.95	148.27

The values of TG in normotensive diabetic and hypertensive diabetic population observed in our study was approximately similar to the values observed by Lorenzo Gorden *et al*50 but, higher values were observed by M. Nakhjavani *et al*49 and Idogun *et al*47. 56 Though mean TG levels were higher in normotensive diabetic males than hypertensive diabetic males, it was not statistically significant (p=0.2368). Similarly mean TG levels in normotensive diabetic female were higher than hypertensive diabetic females, but were not statistically significant (p=0.6371).

Total Cholesterol

Mean total cholesterol in normotensive diabetic and hypertensive diabetic patients was 219.64 + 39.05 mg/dl and 232.04 + 35.96 mg/dl respectively, which was significantly higher as compared to control group i.e. 155.06 + 31.70 mg/dl in a study by Idogun ES *et al*.47 Mean total cholesterol in normotensive diabetic males and normotensive diabetic females was 171.30 + 8.50 mg/dl and 180.58 + 10.05 mg/dl in a study by A.Nyarko *et al*.46 In a study by M.Nakhjavani49 mean total cholesterol in normotensive diabetic males and normotensive diabetic females was 190.30 + 52 mg/dl and 233.67 + 63 mg/dl respectively. In a study by Lorenzo Gorden *et al*50, mean total cholesterol in normotensive diabetic males and hypertensive diabetic males was 197.21 + 56.45 mg/dl and 222.73 + 62.28 mg/dl respectively, which was higher as compared to control males i.e. 174.01 + 28.22 mg/dl. 57 Mean total cholesterol in normotensive diabetic females and hypertensive diabetic females was 217 + 68.83 mg/dl and 286.93 + 63.03 mg/dl, which was higher as compared to control females i.e. 208.81 + 56.07 mg/dl. In our study, mean total cholesterol in normotensive diabetic males and hypertensive diabetic males was 176 + 34.85 mg/dl and 168.04 + 33.03 mg/dl, which was significantly higher as compared to control males i.e. 147.49 + 13.34 mg/dl (P = 0.00001432 and 0.00003853 respectively)

Table 11: Mean total Cholesterol-male (mg/dl)

Age Group	Control	Normotensive Diabetic Males	Hypertensive Diabetic Males
30-39	140.6	187	169
40-49	147	150	166.66
50-59	148.1	185.2	168.33
60-69	153.17	171.33	170
Total Males	147.49	176	168.04

Total cholesterol in normotensive diabetic females and hypertensive diabetic females was 161.65 + 37.07 mg/dl and 160.40 + 34.41 mg/dl, which was higher as compared to control female group i.e. 147.42 + 13.99 mg/dl. (P=0.003853 and 0.001247 respectively)

Table 12: Mean Total Cholesterol- FEMALE (mg/dl)

Age Group	Control	Normotensive Diabetic Females	Hypertensive Diabetic Females
30-39	135.6	160	160
40-49	154.4	153	148
50-59	148.25	184.25	182
60-69	149.62	147	145.5
Total Females	147.42	161.65	160.4

The values of total cholesterol observed in our study were approximately similar to the values observed by A.Nyarko *et al*46, but higher values were observed by Idogun ES *et al*47, M.Nakhjavani *et al*49 and Lorenzo Gorden *et al*50. In our study total cholesterol in normotensive diabetic males was higher as compared to hypertensive diabetic male, but it was not statistically significant (P = 0.7952). 58 Further, in our study, there was no significant difference in mean total cholesterol in normotensive diabetic females and hypertensive diabetic females (P = 0.7367).

Age

Mean age of normotensive diabetic and hypertensive diabetic was 53.9 + 11.2 and 52.2 + 12 respectively, which was not significantly different from control population i.e. 52.46 + 10 (p=0.87 ANNOVA) in a study by Idogun ES, Unuigbe EI *et al*.47 Mean age of diabetic females and diabetic males was 53.7 + 10.6 and 56.1 + 11.3 in given study by M. Nakhjavani *et al*.49 Mean age of normotensive diabetic males and hypertensive diabetic males in our study is 50.82+9.80 yrs and 53.08+7.44 years, which was not significantly different from control male population i.e. 51.50+10.23 years

Table 13: Mean age of patient and control

	Mean Age (yrs)
Normotensive Diabetic Males	50.82 + 9.80
Hypertensive Diabetic Males	53.08 + 7.44
Normotensive Diabetic Females	46.3 + 7.46
Hypertensive Diabetic Females	52.90 + 8.29
Control Males	51.50+ 10.23
Control Females	52.26+ 11.31

Mean age of normotensive diabetic females and hypertensive diabetic females in our study was 46.3 + 7.46 years and 52.90 + 8.29 years, which was not significantly different from control female population i.e. 52.26 + 11.31 years 59 In a study by Idogun ES *et al*47, there was a female predominance i.e. 32/52 (61.5%) as compared to males i.e. 20/52 (38.5%). Similar, there was a female predominance was observed in a study by M. Nakhjavani *et al*.49 Out of 350 patients 250 (71.4%) were females and 100 (28.6%) were males. In a study by

Lorenzo Gorden *et al*⁵⁰, out of 229 patients, 149 (65.06%) were females and 80 (34.94%) were males, which was also showing a female predominance. There was a male predominance in our study. Out of 95 patients, 53 (55.78%) were males and 42 (44.22%) were females

Table 14: Distribution of Patients and Controls

Gender	Patients	Controls
Male	53	28
Female	42	26
Total	95	54

Prevalence of Dyslipidemia

In a study done by Sunil Gupta and Anjali Kapse⁴⁴, hypercholesterolemia (TC >200 mg/dl) was seen in 35.4% of male diabetics and 39.8% of female diabetic patients. Raised LDL (>100 mg/dl) was observed in 29.9% of male diabetic and 35.5% of female diabetic patients. Increased triglycerides (TG > 200 mg/dl) were seen in 42.3% of male diabetic and 25.8% of female diabetic patients. 14.6% of male diabetic had low HDL (< 35 mg/dl) and 65% of female diabetic had low HDL (45 mg/dl). Combined dyslipidemia was 60 observed in 12.2% of male diabetic and 10.8% of female diabetic patients. American diabetic association guideline 1998 was used as criteria for dyslipidemia. In a study done by Udawat H *et al*⁴⁸, dyslipidemia was present in 89% of diabetic patients. LDL > 100 mg/dl was observed in 76% of diabetic patients. HDL dyslipidemia (<35 mg/dl) was present in 58% of diabetic patients. Hypertriglyceridemia (TG > 200 mg/dl) was observed in 22% of diabetic patients. American diabetic association guideline 1998 was used as criteria for dyslipidemia. The criteria we used for dyslipidemia was as per American Diabetic Association guideline 2010²⁶. As per ADA 2010, LDL < 100 mg/dl, HDL > 50 mg/dl for female, HDL>40mg/dl for male and TG < 150 mg/dl was considered as a low risk lipid profile. In our study, 57.14% of normotensive diabetic males and 60% of hypertensive diabetic males had LDL > 100 mg/dl. In our study, 60% of normotensive diabetic females and 59.09% of hypertensive diabetic females had LDL > 100 mg/dl (Table No.15, 16). The prevalence is approximately similar to the study by Udawat H *et al*⁴⁸. A little lower prevalence was observed by Kapse *et al*⁴⁴. 61 In our study, 42.85% of normotensive diabetic males and 40% of hypertensive diabetic males had TG > 150 mg/dl. 45% of normotensive diabetic females and 40.90% of hypertensive diabetic females had TG > 150 mg/dl

Table 15: Prevalence of dyslipidemia-males

	% of Normotensive Diabetic Male	% of Hypertensive Diabetic Male
LDL>100m g/dl	57.14	60
TG>150mg /dl	42.85	40
HDL<40m g/dl	57.14	68

	% of Normotensive Diabetic Female	% of Hypertensive Diabetic Female
LDL>100 mg/dl	60	59.09
TG>150m g/dl	45	40.9
HDL<40m g/dl	85	81.81

Table 16: Prevalence of dyslipidemia-females

A lower prevalence was observed by previous studies i.e. Udawat H *et al*⁴⁸ and Kapse *et al*⁴⁴, probably because of higher level of triglycerides (> 200 mg/dl) was taken as cut off point as per ADA guideline 1998. In our study, 57.14% of normotensive diabetic males and 68% of hypertensive diabetic males had HDL < 40 mg/dl. 85% of normotensive diabetic females and 81.81% of hypertensive diabetic females had HDL < 50 mg/dl A lower prevalence was observed by previous studies i. e. Udawat H *et al*⁴⁸ and Kapse *et al*⁴⁴, probably because of lower levels of HDL (HDL<35 mg/dl for male and HDL<45mg/dl) was taken as cut off points as per ADA guideline 1998.

SUMMARY

Lipoproteins are complexes of lipids and proteins that are essential for the transport of cholesterol, triglycerides and fat soluble vitamins. Abnormalities in plasma lipoprotein and derangement in lipid metabolism rank among the most firmly established and best understood risk factors for atherosclerosis. Type 2 diabetes mellitus, hypertension and dyslipidemia frequently occur together and in association with insulin resistance. The Recognition that cardiovascular risk factor tends to cluster within individual has important implication for evaluation and treatment which should address overall risk and not simply focus on hypertension or diabetes alone. This cross sectional study was conducted during the period of December 2008 to June 2010.⁴⁸ Patient of normotensive diabetes mellitus type 2 (28 males and 20 females) and 47 patient of hypertensive diabetes mellitus type 2 (25 males and 22 females) presented to Kamalnayan Bajaj Hospital were included in study.⁵⁴ healthy control population (28 males and 26 females) were selected from hospital 64 employee, staff and candidate from routine health check up. Objective of study was to compare lipid profile in normotensive diabetes mellitus type 2 and hypertensive diabetes

mellitus type 2. Normotensive diabetic patients were compared with hypertensive diabetic patients using unpaired t-test. P value of <0.05 was considered statistically significant to compare lipid profiles. Mean LDL-C in normotensive diabetic males and hypertensive diabetic males were $105.14 + 23.89$ and $107.72 + 26.22$ respectively, which were significantly higher as compared to normal control males i.e. $94.85 + 9.73$ [$p=0.000012$ and $p=0.002589$ respectively]. Though mean LDL-C was higher in hypertensive diabetic males than normotensive diabetic males, it was not statistically significant [$p=0.57$]. Mean Triglyceride in normotensive diabetic males and hypertensive diabetic males were $162.5 + 63.70$ and $148.92 + 80.61$ respectively, which were significantly higher as compared to normal control males i.e. $106.32 + 22.48$ [$p=0.00000061$ and $p < 0.0000001$ respectively]. Though mean triglycerides was higher in normotensive diabetic males than hypertensive diabetic males, it was not statistically significant [$p=0.2368$]. Mean HDL-C in normotensive diabetic males and hypertensive diabetic males were $38.42 + 8.25$ mg/dl and $37.52 + 8$ mg/dl which were significantly lower as compared to control males i.e. $45.61 + 5.31$ mg/dl [$p=0.02551$ and $p=0.04$ respectively]. Though mean HDL-C in normotensive diabetic males were higher than hypertensive diabetic males, it was not statistically significant [$p=0.8842$]. Mean total cholesterol in normotensive diabetic males and hypertensive diabetic males were $176.00 + 34.85$ and $168.04 + 33.03$ respectively, which were significantly higher as compared to control males viz. $147.49 + 13.30$ [$p=0.00001432$ and $p=0.00003853$ respectively]. Though mean total cholesterol in normotensive diabetic males were higher than hypertensive diabetic males, it was not statistically significant [$p=0.7952$]. Mean LDL-C in normotensive diabetic females and hypertensive diabetic females were $101.9 + 25.27$ and $103.36 + 26.09$ respectively, which were significantly higher as compared to normal control females i.e. $96.07 + 6.78$ [$p < 0.0000001$ and $p < 0.0000001$ respectively]. Though mean LDL-C in hypertensive diabetic females was higher than normotensive diabetic females, it was not statistically significant [$p=0.8940$]. Mean Triglyceride in normotensive diabetic females and hypertensive diabetic females were $151.95 + 69.94$ and $148.27 + 77.99$ respectively, which were significantly higher as compared to normal control females i.e. $105.26 + 21.73$ [$p=0.00000027$ and $p < 66 0.0000001$ respectively]. Though mean triglyceride in normotensive diabetic females was higher than hypertensive diabetic females, it was not statistically significant [$p=0.6371$]. Mean HDL-C in normotensive diabetic females and hypertensive diabetic females were $39.25 + 7.26$ and $40.31 + 9.20$

respectively, which were significantly lower as compared to normal control females i.e. $45.92 + 4.68$ [$p=0.0016$ and $p=0.04$ respectively]. Though mean HDL-C in hypertensive diabetic females was higher than normotensive diabetic females, it was not statistically significant [$p=0.30$]. Mean Total Cholesterol in normotensive diabetic females and hypertensive diabetic females were $161.65 + 37.07$ and $160.40 + 34.41$ respectively, which were significantly higher as compared to normal control females i.e. $147.42 + 13.99$ [$p=0.003853$ and $p=0.001247$ respectively]. Though mean total cholesterol in normotensive diabetic females was higher than hypertensive diabetic females, it was not statistically significant [$p=0.7361$]. Though normotensive diabetic and hypertensive diabetic had significant dyslipidemia as compared to control population, there was no statistically significant difference in lipid profile pattern in normotensive diabetic and hypertensive patient.⁶⁷

CONCLUSION

We compared lipid profile and prevalence of dyslipidemia in normotensive diabetic and hypertensive diabetic patients with age and sex matched healthy controls. Though normotensive diabetic and hypertensive diabetic had significant dyslipidemia as compared to control population, there was no statistically significant difference in lipid profile pattern in normotensive diabetic and hypertensive patient. It may be due to insulin resistance which is common pathologic link between diabetes mellitus type 2 hypertension and dyslipidemia. Low HDL level was most common form of dyslipidemia in both normotensive diabetic and hypertensive diabetic patients. HDL dyslipidemia was more prevalent in hypertensive diabetic female patient. Decision to start lipid lowering agent was guided by LDL level. Lipid profile should be done as baseline investigations in evaluating normotensive diabetic and hypertensive diabetic patients and should be reevaluated after starting lipid lowering agents in view of achieving safe lipid profile level which will collectively decrease cardiovascular risk, albeit with good control of diabetes and hypertension.

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