LIPID PROFILE PATTERN IN DIABETICS FROM CENTRAL INDIA*

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ABSTRACT

The objective of the study was to evaluate the fasting lipid profile pattern in diabetics and co-relate it with dietary habits, waist hip ratio (WHR) body mass index(BMI), hypertension(HT), coronary artery disease(CAD) and pattern of hyperglycemia. 257 diabetic males and females, between 30 to 65 years of age were studied. More than 30% of diabetics had dyslipidemia. Hypercholesterolemia and raised LDL-C was as common as hypertriglyceridemia.11-12% of patients had combined dyslipidemia. Patients with fasting blood glucose (FBG) >140mg% had higher incidence of dyslipidemia as compared to patients with FBS < 140mg%. Higher BMI and WHR were associated with raised total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG) and combined dyslipidemia in males. Females with higher WHR had increased TC and LDL- C. Higher BMI did not show such a relationship in females. WHR seems to be better marker of dyslipidemia than BMI. 56.1% of males and 58.1% of females were not consuming ghee. Amongst female with dyslipidemia, significantly higher TC, LDL-C and combined dyslipidemia was observed in those consuming ghee (8.2gm /day). No such co-relation was seen in males. HDL-C was found to be normal in both groups(41 ± 7.9 mg% in male and 43.7 ± 9.8 mg% in females). 27.4% of males and 21.5% of females had CAD in the study group. Dietary fat intake was not higher than recommended in them. Incidence of dyslipidemia was found to be higher in CAD than in HT group. In conclusion, incidence of dyslipidemia in diabetics and diabetic with CAD is >30% in both sexes from Central India, despite having normal unsaturated fat and low saturated fat intake.

KEY WORDS: Dyslipidemia; Diabetes; Dietary fat; Hyperglycemia; Waist - hip ratio; BMI; Coronary artery disease.

INTRODUCTION

Lipoprotein abnormalities are common in diabetes and contribute significantly to its complications. The misconception that such abnormalities are always secondary to poor glycemic control focuses most of the attention on the management of hyperglycemia. As a result, the treatment of dyslipidemia was often neglected, despite convincing evidence linking it to the development of atherosclerosis. Lipoprotein abnormalities often precede the onset of diabetes mellitus by many years and persist despite achievement of euglycemia, particularly in type 2 diabetes. The compounding effects of age, obesity, ethanol, antihypertensive drugs, diet and separately inherited lipid disorders, often aggravate them. Consequently lipoprotein disorders in type 2 diabetes should be considered as distinct entities. Lipid abnormalities associated with type 1 diabetes also predispose to atherosclerosis, but in contrast to type 2 diabetes, these abnormalities can often be reversed by appropriate glycemic control(1).In recent years, prevention of the microvascular complications of diabetes has been shown to be possible with aggressive treatment of hyperglycemia. Unfortunately, trials on the prevention of macrovascular complications of diabetes and insulin-resistant states are currently lacking. This is somewhat surprising, given that these complications are the important cause of morbidity and mortality associated with both type 1 and type 2 diabetes, with a twofold to threefold increased incidence in men and an up to six fold increase in women compared to age- matched, non diabetic individuals [2-5]. Despite the absence of definitive clinical trials, mounting evidence from both basic and clinical research, allows us to appreciate aspects of the pathophysiology of macrovascular disease in diabetes mellitus and to propose interventions to reduce its incidence. Lipid abnormalities play an important role in the causation of diabetic atherosclerosis [6,7], but the pathophysiology is complex and clearly multifactorial, with dysfunction of the fibrinolytic system [8], pro-oxidative state [9], hyperglycemia [10-13] and possibly hyperinsulinemia [14,15] also explaining part of the increased susceptibility of people with diabetes to atherosclerotic complications.

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The most common pattern of dyslipidemia in type 2 diabetic patients is elevated triglyceride levels and decreased HDL cholesterol levels. The concentration of LDL cholesterol in type 2 diabetic patients is usually not significantly different from non-diabetic individuals. Diabetic patients may have elevated levels of non-HDL cholesterol (LDL plus VLDL). However, type 2 diabetic patients typically have a preponderance of smaller, denser LDL particles, which possibly increases atherogenicity. Lastly, as shown in the technical review (16), the median triglyceride level in type 2 diabetic patients is >200 mg/dl and 86% of patients have triglyceride levels below 400 mg/dl.

MATERIAL AND METHODS

All diabetics between ages of 30 to 65 years of both sexes were selected. Following group of patients were excluded from the study.

- Patients with renal failure
- Chronic alcoholism
- Familial dyslipidemia.
- Thyroid or other endocrine disorder.
- Those on lipid lowering drugs.

Fasting total cholesterol,triglycerides and HDL was tested by "End point Biochemistry" method. The serum LDL cholesterol concentration was calculated from the serum concentrations of total cholesterol, HDL cholesterol and triglycerides using the formula, LDL-C = TC -(HDL-C+TG/5)(mg/dl). The VLDL cholesterol concentration was calculated from the values of TG (as TG/5). Parallel fasting and 2 hours post prandial blood glucose were performed. Simultaneously, calories, proteins and fat intake of all individuals was calculated by 24 hours dietary recall method. WHR and BMI was calculated. History was taken in detail regarding hypertension, CAD, stroke and resting ECG was done in all patients. They were divided into male and female groups, which were again subdivided as per WHR, BMI, FBG, CAD, HT and type of fat consumed.

The laboratory values of serum lipids, were entered into computer and computer analysis of the data was obtained for various statistical indices.

OBSERVATIONS

Hypercholesterolemia was seen in 35.4% and 39.8% of females. Raised LDL was observed in 29.9% of male and 35.5% females. Increased triglycerides were seen in 32.3% of male and 25.8% of females. Combined dyslipidemia was observed in 12.2% of male and 10.8% of female population (Table 1).

Table 1 : Incidence of Dyslipidemia Amongst Male and Female Population

Category	CHOL>200	LDL>130	TG>200	COMB.DYS*
Male (164)	35.4%	29.8%	32.3%	12.2%
Female (93)	39.8%	35.5%	25.8%	10.7%

**LDL>130 and TG>200. Figures in parenthesis represent the number of patients*

Mean age was similar in both groups (Table 2). Mean WHR was high in both sexes, suggestive of central obesity in this population, while generalized obesity was more prominent in females than males. Mean TC and TG, was < 200 mg% and mean HDL was > 40 mg% in both groups. Mean LDL was <130mg% in both groups, but was higher in females than males. Saturated and unsaturated fat intake in both groups was appropriate, as per recommendations.

Table 2: Mean Values with Standard Deviations of Lipid Profile, Anthropometry and Fat Intake in Diabetics .

		MALE (n= 164) MEAN		SD	FEMALE (n= 93) MEAN		SD
Age	(yrs)	50.8	±	10.0	49.9	±	9.3
BMI	(kg/m^2)	25.3	±	4.1	28.1	±	4.8
WHR		0.99	±	0.06	0.96	±	0.07
CHOL	(mg/dl)	186.6	±	40.7	200.8	±	146.7
TG	(mg/dl)	178.7	±	107.7	171.5	±	99.1
HDL	(mg/dl)	41.5	±	7.9	43.7	±	9.8
LDL	(mg/dl)	108.7	±	36.7	121.5	±	38.1
VLDL	(mg/dl)	35.7	±	21.5	34.3	±	19.8
CAL	(Kcal)	1829	±	283	1628	±	233
PRO	(gm)	42.5	±	107.6	38.6	±	7.0
Fat(U)	(gm)	36.1	±	13.8	37.1	±	13.8
Fat(S)	(gm)	3.5	±	5.3	3.4	±	6.2

** CAL-calories; PRO-protein; (U) unsaturated; (S) saturated*

Both groups were compared on the basis of their hyperglycemic status. Mean lipid profile didn't show any significant difference with respect to normal or high blood glucose levels in both groups.

Table 3- Prevalence of Dyslipidemia in Controlled and Uncontrolled Diabetics.

MALE	NO	CHOL>200	LDL>130	TG>200	COMB.DYS
FBS<140	92	26.1%	25.0%	27.2%	8.7%
FBS>140	72	37.5%	29.2%	33.3%	12.5%
FEMALE	**NO**	**CHOL>200**	**LDL>130**	**TG>200**	**COMB.DYS**
FBS<140	44	38.6%	29.5%	18.2%	4.5%
FBS>140	49	51.0%	38.8%	32.6%	16.3%

The prevalence of dyslipidemia in both groups were compared on the basis of fasting blood glucose and it was found that prevalence of hypercholesterolemia, hypertriglyceridemia and combined dyslipidemia was higher in male as well as in female population with FBG >140mg% (Table 3).

Table 4:- Corelation of Lipid Profile with WHR.

FEMALE	NO	CHOL>200	LDL>130	TG>200	COMB
WHR <0.88	12	16.66%	8.33%	33.33%	0.00%
WHR >0.88	81	49.38%	39.5%	24.69%	12.35%
MALE	**NO**	**CHOL>200**	**LDL>130**	**TG>200**	**COMB**
WHR <0.9	14	28.57%	35.7%	14.28%	0.00%
WHR >0.9	150	31.33%	24%	31.33%	10.66%

In the male group no statistically significant difference was found in mean lipid profile of patient with higher BMI and WHR. But the incidence of dyslipidemia was higher in males with higher BMI and high WHR. In the female group mean TC, TG, LDL levels were directly proportional to higher WHR (Table 4 and 5), while comparision with BMI was inconclusive. There was higher incidence of dyslipidemia in females with high WHR. No statistically significant difference in fat intake was seen in both groups i.e with normal or higher BMI and WHR.

Table 5:- Corelation of Lipid Profile with BMI

MALE	NO	CHOL>200	LDL>130	TG>200	COMB
BMI <25	93	26.88%	22.58%	27.85%	7.52%
BMI >25	71	35.21%	32.39%	30.98%	12.6%
FEMALE	**NO**	**CHOL>200**	**LDL>130**	**TG>200**	**COMB**
BMI <25	27	51.85	40.74	22.222	14.82
BMI >25	66	42.42	31.81	27.27	9.09

Table 6 : Incidence of Dyslipidemia in CAD and Non-CAD group

FEMALE	NO	CHOL>200	LDL>130	TG>200	COMB
CAD	20	40%	40%	5%	5%
NONCAD	73	45.2%	34.2%	31.5%	11.0%
MALE	**NO**	**CHOL>200**	**LDL>130**	**TG>200**	**COMB**
CAD	55	33.3%	40%	24.4%	13.3%
NONCAD	109	25.7%	24.8%	25.7%	7.3%

Of the total, 33.5% of male and 21.5% of female patients had CAD(on the basis of resting E.C.G). There was higher incidence of dyslipidemia in male CAD population. This relationship was not observed in female patients. Saturated fat and unsaturated fat intake in both groups was similar (Table 6).

Mean HDL levels were found to be more than 41 mg/dl in both male and female groups. Normal HDL levels in male(>45mg%) and in female (>55mg%) were seen in only 18.9% and 5.4% respectively.

14.6% of male of had low HDL (<35mg%) and 68.8% of female had low HDL (<45mg%). In patients with CAD, contrary to common belief (in both male and female groups), HDL levels were better than in non CAD group.

Table 7 :- Dietary Fat and its Relation with Subsets. Incidence of CAD and HT Corresponding to Type of Fat Consumed

MALE (n=164)

TYPE OF FAT	INCIDENCE	%	CAD	%	HT	%
GROUND. NUT(GN)	50	30.5	12	24	18	36
SOYABEAN(SB)	26	15.9	10	38.5	9	34.6
SUNFLOWER(SF)	16	9.8	5	31.3	9	56.3
GHEE+SF	12	7.3	4	33.3	8	66.7
GHEE+ SB	7	4.3	1	14.3	3	42.9
GHEE+GN	53	32.3	23	43.4	22	41.5

FEMALE (n=93)

TYPE OF FAT	INCIDENCE	%	CAD	%	HT	%
GROUND NUT(GN)	40	43.0	7	17.5	14	35
SOYABEAN (SB)	8	8.6	2	25	4	50
SUNFLOWER(SF)	8	8.6	5	63.5	6	75
GHEE+SF	3	3.2	1	33.3	1	33.3
GHEE+ SB	4	4.3	0	0	2	50
GHEE+GN	30	32.2	5	16.7	12	40

43.9% males and 41.9% females were consuming ghee. The mean ghee intake in male was 7.9gm and that of female was 8.3gm. Ground nut oil was the main edible oil used in this population. Saturated fat, unsaturated fat and calorie intake in our population was found to be appropriate as per recommendations with respect to calorie intake (Table 7).

In the male group of CAD, incidence was found to be lowest in population having a combination of ghee and soyabean oil, and was highest in group having combination of ghee and ground nut oil. In female no cases of CAD were seen in patients on ghee +soyabean oil combination and CAD rate and HT rate was highest in patients consuming sunflower oil ie 63.5% and 75% respectively.

DISCUSSION

A significant relationship has been demonstrated between hypercholesterolemia and CAD in the Western world. However, in Madras, India, 75% of people with myocardial infarction (MI) had plasma cholesterol levels less than 200 mg/dl(17,18). In another study from India, even lower level of plasma cholesterol (<150 mg/dl) in patients with CAD has been reported(19). In Durban, South Africa, up to 62 percent of Indian patients with MI had high total cholesterol levels while their HDL cholesterol was low(20).

Among expatriate Indians living in the UK., their total plasma cholesterol has been found to be low compared to that in the natives (21). Among those expatriates living in the USA on the other hand, the total and low density lipoprotein cholesterol levels were similar to that of the European Americans, while the high density lipoprotein cholesterol (HDL) was lower in the former (22). Low plasma HDL level is a powerful risk factor of CAD, while high level protects from the disease both in men and women. In USA, only 14% of South Asian men and 5% of such women had optimal plasma HDL levels (>55mg/dl for men and >66mg/dl for women). In general, the Indian men had 5mg/dl lower HDL than that in the European Americans and 15 mg/dl lower than that among Japanese Americans.

Ours was a cross-sectional study performed on outpatient type 2 diabetic subjects. We found the prevalence of CAD among type 2 diabetic males to be 33.5% and in females it was 21.5%. Various studies report widely variable prevalence of CAD among diabetics in India (6.6% to 33%). In a WHO multinational study (23,24), the prevalence of any ECG abnormality among type 2 diabetic patients from New Delhi was reported as 19% . There is comparatively higher prevalence of CAD in our study, which may be due to the small number of the study group and also because being a private centre, it is attended by a selected population. It is noteworthy that the ECG and history based diagnostic criteria are known to under-estimate the actual prevalence of CAD among type 2 diabetics. If other tests such as treadmill test, echocardiography, angiography, etc, are performed to establish the presence of CAD in type 2 diabetics, comparable prevalence of CAD is even higher than the prevalence reported in this population.

Diabetic dyslipidemia is characterized by high triglycerides, low HDL and normal LDL cholestrol in most of the patients. In our study we have observed that more than 30% of patients had dyslipidemia, where as the incidence of hypercholesterolemia and raised LDL cholestrol was equally high as that of triglycerides. Mean lipid levels in both groups were normal. Average saturated and unsaturated fat intake in both groups was normal with respect to their calorie intake. 56% and 58.1% of males and females respectively of total study group was not consuming ghee in their regular diet. In this age group (30-65 years), central and generalised obesity was prominent in both males and females. Mean BMI was higher in females than males. Though mean lipid levels didn't show any difference with respect to their blood glucose status, the incidence of raised cholesterol, LDL and TG was higher in uncontrolled diabetics (FBG >140 LC%) in both groups. Thus a control of hyperglycemia does reduces incidence of dyslipidemia in both sexes. Similar observations were documented in WHR and BMI, where mean lipid levels remained normal irrespective of their built, but incidence dyslipidemia was higher in male diabetics with high WHR and BMI. In females this relationship persisted with WHR, but not with BMI. This finding suggests that WHR is a better indicator than BMI for dyslipidemia in a diabetic population. 33.5% of male and 21.5% of female diabetics had CAD, indicating every third diabetic male and every fifth diabetic female is suffering from coronary artery disease. High lipid levels were seen in males who had coronary artery disease, but this was not

observed in the female group. Probable reason may be that the number of females with CAD is very small in this group to reach any satisfactory conclusion.

Mean HDL levels in both groups was >41mg%. It is observed that 82% of male and 94.6% of female in our population have low HDL levels. In patients with CAD, HDL cholesterol levels were higher than in non CAD group, this suggest that some other causes of CAD should be looked for in this group.

This population seemed to be fat conscious, thus 56% of male and 58% of female were not taking ghee at all. Ground nut oil is commonly used edible oil and soyabean is second common in use. Mustard oil is not used for regular diet in this population. Amongst different oils used, soyabean + ghee combination was found to be the best and sunflower oil intake seemed to be worst for coronaries of diabetics. This is because of better ratio of n3 : n6 , PUFA in ghee and soyabean oil.

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