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Lipid Profile in Prediabetes - A Comparative Study

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ABSTRACT

Background: Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycemia with deranged fat, carbohydrate and protein metabolism that results from improper secretion or action of insulin. The precursor state to diabetes mellitus is called as Prediabetes in which not all symptoms of diabetes are present but the blood sugar is abnormally high. Dyslipidemia which as often as possible happens in diabetes play out an imperative job in quickening of macrovascular difficulty and add to expand danger of cardiovascular ailment. We conducted this study to assess the role of lipid profile in prediabetics, compared between group of asymptomatic diabetes and healthy controls. **Methods:** This was a hospital based cross sectional case control study in which 89 individuals with established diagnosis of Prediabetics were included on the basis of a predefined inclusion and exclusion criteria.89 healthy aged matched individuals were enrolled in the control group. A detailed personal, family and past history was taken in all the cases and a thorough clinical examination was done. Family history of diabetes and hypertension was particularly asked and noted down. Demographic details such as age, sex and socioeconomic status was noted in all the cases. Weight and BMI was analyzed. Diagnosis of prediabetes was done on the basis of ADA criteria. Lipid Profile were carried out under the guidance of physician for all cases and data was recorded for evaluation. Statistical analysis was done using SSPS 21.0 software. P value less than 0.05 was taken as statistically significant. **Results:** Out of a total 178 patients there were 96 males and 82 females with an M: F ratio of 1:0.854. The mean age of patients in group 1 and 2 was 50.92 ± 12.42 and 50.30 ± 12.64 respectively. The mean BMI of subjects in Group 1 was 25.58 ± 3.25kg/m2 and 25.80 ± 3.43 kg/m2 respectively. The mean age and BMI of the patients was found to be comparable in both the groups. The mean systolic and diastolic blood pressure values were found to be comparable in both the groups with no statistically significant difference (P>0.05). The FBS and PPBS values of subjects in Group 1 were significantly lesser (93.77±15.47mg/dl and 121.79±11.29mg/dl) as compared to FBS and PPBS values of subjects in Group 2 (112.52±16.40mg/dl and 177.23±17.31mg/dl). This difference was statistically significant as per Student t-test (p<0.05). The Glycosylated Hemoglobin (HbA1c) values of subjects in Group 1 (5.27±0.25%) were significantly lesser as compared to HbA1c values of subjects in Group 2 (6.14±0.34%). Total cholesterol, Triglycerides, LDL, HDL, VLDL, TG/HDL and LDL/HDL ratio were found to be statistically significantly different in both the groups (P<0.05). **Conclusion:** Lipid profile in prediabetic subjects containing Total cholesterol, TG, TG/HDL ratio and LDL/HDL ratio are remarkably raised compared to normal healthy subjects and HDL cholesterol is lower than normal subjects. These finding underlines the need for detection of prediabetics so that appropriate interventions can be done.

Keywords: Prediabetes, Lipid Profile, Lifestyle Modification, Glycosylated Hemoglobin.

INTRODUCTION

The precursor state to diabetes mellitus is called as Prediabetes in which not all symptoms of diabetes are present but the blood sugar is abnormally high. This abnormal high blood glucose level stage is called as "grey area". Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycemia with deranged fat, carbohydrate and protein metabolism that results from improper secretion or action of insulin1.It is a modern day epidemic. The WHO Global Report on Diabetes has revealed that the number of adult diabetics in the world was 422 million in 2014 in comparison to 108 million in 19802.The age standardized prevalence of diabetes has become 8.5% in the adult population, almost double that of the 4.7% in 1980 due to which WHO estimates that diabetes will become the seventh most common cause of mortality, worldwide, in the year 2030.[3]

The maximum occurrence of diabetes in the world would occur in India according to World Health Organization.[4] The prevalence of diabetes was 12.1% and that of Prediabetes was 14% according to National Urban Diabetes Survey. The prevalence of diabetes was 62.4 million in 2011 and pre-diabetes was 77.2 million respectively in India.[5] The

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weighted prevalence of diabetes (both known and newly diagnosed) was 10.4% in Tamil Nadu, 8.4% in Maharashtra, 5.3% in Jharkhand, and 3.6% in Chandigarh. The prevalence of Prediabetes (impaired fasting glucose and/or impaired glucose tolerance) was 8.3% in Tamil Nadu, 12.8% in Maharashtra, 8.1% in Jharkhand and 14.6% in Chandigarh.[6]

Excessive body weight and sedentary lifestyle are most common causes which are present in type 2 DM. 90% of diabetes in the world are Type 2 DM. Diagnosis of type 2 DM is difficult as mostly it is asymptomatic and presents with complication such as cardiovascular disease, nephropathy, neuropathy, retinopathy cerebrovascular disease like stroke and peripheral vascular disease.[7] About half the diabetes in the world are not diagnosed according to recent studies. "Prediabetes" a new class of blood sugar level which precede the onset of diabetes has been introduced by American Diabetic Association. Prediabetic individuals, have a higher risk of progression to diabetes in the future.[8] American Diabetic Association has defined pre-diabetes as Impaired Fasting Glucose, when fasting plasma glucose level ranges from 100 to 125 mg/dl and Impaired Glucose Tolerance, when plasma glucose level 2-h after an oral glucose tolerance test ranges from 140 to 199 mg/dl9. Prediabetic screening can stop early progression to diabetes and also prevent complication. IFG and IGT build danger for cardiovascular pathology. Dyslipidemia which as often as possible happens in diabetes play out an imperative job in quickening of macrovascular difficulty and add to expand danger of cardiovascular ailment. Dyslipidemia in type 2 diabetes mellitus is characterized by increased triglyceride, reduced amount of high density lipoprotein and presence of small dense low density lipoprotein particles.[10]

The absence of Prediabetes direction and screening on diabetes drives the condition that makes Prediabetes unnoticed and unwatched. Taking a gander at the predominance and the intricacy related with cardiovascular illness in diabetes, it is getting to be important to analyze Prediabetes and think about their lipid profile to keep them from creating over diabetes. Hence the present study was done at our tertiary care center to assess the role of lipid profile in Prediabetes, compared between group of asymptomatic diabetes and healthy controls.

MATERIALS AND METHODS

This was a hospital based cross sectional case control study in which 89 individuals with established diagnosis of Prediabetics were included on the basis of a predefined inclusion and exclusion criteria. The study was conducted in the department of medicine of a tertiary care medical college situated in an urban area. Institutional ethical committee duly approved that study and written informed consent was obtained from participants. 89 healthy age matched individuals were enrolled in the study as control group.

- **Group 1:** Healthy participants between ages 20-70 years of both sexes who on clinical evaluation were not suffering from diabetes, any acute or chronic ailments, on any medication which could influence lipid profile
- **Group 2:** Men and women aged 20-70 years having established diagnosis of prediabetics

A detailed personal, family and past history was taken in all the cases and a thorough clinical examination was done. Family history of diabetes and hypertension was particularly asked and noted down. Demographic details such as age, sex and socioeconomic status was noted in all the cases. Weight and BMI was analyzed. Diagnosis of prediabetes was done on the basis of ADA criteria. Lipid Profile were carried out under the guidance of physician for all cases and data was recorded for evaluation.

Table 1: Diagnostic Criteria for diabetes and pre-diabetes (ADA 2016)

Diagnosis	Fasting Plasma Glucose	2-hour OGTT	HbA1C
Normal	<100mg/dl (5.6mmol/l)	<140 mg/dl (7.8 mol/l)	<5.7%
Pre-diabetes	100-125 mg/dl (5.6-6.9 mmol/l)	140-199 mg/dl (7.8- 11.0 mmol/l)	5.7-6.4%
Diabetes	≥126 mg/dl(7.0mmol/l)	≥200mg/dl (11.1 mmol/l)	≥6.5%

(IGF-impaired fasting glucose, IGTT- Impaired Glucose tolerance test FPG- Fasting plasma Glucose, OGTT-Oral Glucose Tolerance Test)

Quantitative data is presented with the help of Mean and Standard deviation. Comparison among the study groups is done with the help of unpaired t test as per results of normality test. Qualitative data is presented with the help of frequency and percentage table. Association among the study groups is assessed with the help of Fisher test, student's' test and Chi-Square test. 'p' value less than 0.05 is taken as significant.

Inclusion Criteria:

Cases

Adult patients 18-70 years with prediabetic status or asymptomatic diabetes, according to ADA and IDF criteria. (ADA 2016)

- FPG 110 mg/dL(5.6mmol/L) to 125 mg/dL(6.9mmol/L) (IFG)

OR

- 2-hour PG in the 75-g OGTT 140mg/dL(7.8 mmol/L) to 199mg/dL(11.0 mmol/L)(IGT)

OR

- HbA1c 5.7-6.4 %
- Patients willing to give written signed consent.

Control In This Study: Patients (Age Matched) who were non diabetic and normal subject according to ADA and IDF criteria. (ADA 2016)

Exclusion criteria:

- Age less than 18 years or above 70 years
- Those who refused consent
- Diabetic patient Type 1 and Type 2
- Patients with active autoimmune disease, malignancy, hypothyroidism, SLE
- Patients having concomitant use of drugs like glucocorticoids

RESULTS

Out of 178 studied cases there were 49 (55.1%) and 47 (52.8%) male subjects in Group 1 and Group 2 respectively while female subjects constituted 44.9% and 47.2% of the study groups respectively. The gender distribution was found to be comparable with no statistically significant difference amongst the studied groups (P>0.05)

Table 2: Distribution of subjects according to Gender

Gender Distribution	Group 1		Group 2	
	N	%	N	%
Male	49	55.1%	47	52.8%
Female	40	44.9%	42	47.2%
Total	89	100%	89	100%
P>0.05 (Not Significant)				

Majority of the subjects in Group 1 were in the age group of 51-60 years (32.9%) and the mean age of the subjects was 50.92 ± 12.42 years. Majority of the subjects in Group 2 were in the age group of 51-60 years (29.3%) and the mean age of the subjects was 50.30 ± 12.64 years. There was no significant difference between the groups as per Student t-test (p>0.05).

Table 3: Age Groups in the studied cases

Age Groups	Group 1		Group 2	
	N	%	N	%
20-30 years	7	7.8%	5	5.6%
31-40 years	15	16.8%	17	19.1%
41-50 years	14	15.6%	19	21.3%
51-60 years	29	32.9%	26	29.3%
61-70 years	24	26.9%	22	24.7%
Total	89	100%	89	100%
Mean ± SD	50.92 ± 12.42		50.30 ± 12.64	
P>0.05 (Not Significant)				

36 (40.5%) subjects in Group 1 were in the normal range while 45 (50.6%) and 8 (8.9%) subjects were overweight and obese respectively. The mean BMI of subjects in Group 1 was 25.58 ± 3.25kg/m^2. 34 (38.2%) subjects in Group 2 were in the normal range while 46 (51.7%) and 9 (10.1%) subjects were overweight and obese respectively. The mean BMI of subjects in Group 1 was 25.80 ± 3.43kg/m2. There was no significant difference between the groups as per Student t-test test (p>0.05).

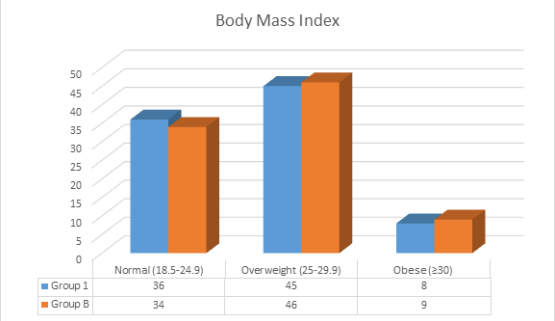

Figure 1: Body mass index in both the groups.

The systolic and diastolic blood pressure (SBP and DBP) values of subjects in Group 1 (120.31± 12.51mmHg and 76.51±9.89mmHg) were comparable to SBP and DBP values of subjects in Group 2 (121.24±11.79mmHg and 77.17± 8.35mmHg). This difference was statistically not significant as per Student t-test (p>0.05).

Table 4: Systolic and diastolic blood pressure values in studied cases.

Parameters	Group 1		Group 2		p
	Mean	SD	Mean	SD	Value
SBP (mmHg)	120.31	12.51	121.24	11.79	>0.05
DBP (mmHg)	76.51	9.89	77.17	8.35	>0.05

The FBS and PPBS values of subjects in Group 1 were significantly lesser (93.77±15.47mg/dl and 121.79±11.29mg/dl) as compared to FBS and PPBS values of subjects in Group 2 (112.52±16.40mg/dl and 177.23±17.31mg/dl). This difference was statistically significant as per Student t-test (p<0.05).

Table 5: Fasting and Post Prandial Blood Glucose levels in the studied cases.

Parameters	Group 1		Group 2		p
	Mean	SD	Mean	SD	Value
FBG (mg/dl)	93.77	15.47	112.52	16.40	<0.05
PPBG (mg/dl)	121.79	11.29	177.23	17.31	<0.05

The Glycosylated Hemoglobin (HbA1c) values of subjects in Group 1 (5.27±0.25%) were significantly lesser as compared to HbA1c values of subjects in Group 2 (6.14±0.34%). This difference was statistically significant as per Student t- test (p<0.05).

Table 6: Comparison of Glycosylated hemoglobin levels in the studied cases.

Parameters	Group 1		Group 2		p
	Mean	SD	Mean	SD	Value
HbA1c (%)	5.27	0.25	6.14	0.34	<0.05

The mean Total Cholesterol value in Group 1 (172.75 ± 34.57mg/dL) was significantly lower than Group 2 (183.28 ± 43.76mg/dL) as per Student t-test

(p<0.05). The mean Triglyceride value in Group 1 (109.56 ± 30.20mg/dL) was significantly lower than Group 2 (139.78 ± 23.52mg/dL) as per Student t-test (p<0.05). The mean LDL value in Group 1 (97.97 ± 16.03mg/dL) was significantly lower than Group 2 (120.62 ± 28.60mg/dL) as per Student t-test (p<0.05).The mean HDL value in male patients of Group 1 (44.02 ± 8.55mg/dL) was significantly higher than male patients of Group 2 (38.17 ± 7.37mg/dL) as per Student t-test (p<0.05). The mean HDL value in female patients of Group 1 (42.50 ± 13.34mg/dL) was significantly higher than female patients of Group 2 (36.14 ± 6.80mg/dL) as per Student t-test (p<0.05). The mean VLDL value in Group 1 (23.56± 7.85mg/dL) was significantly lower than Group 2 (31.57 ± 7.40mg/dL) as per Student t-test (p<0.05).The mean TG/HDL Ratio value in Group 1 (2.65 ± 0.89) was significantly lower than Group 2 (3.86 ± 0.85) as per Student t-test (p<0.05). The mean LDL/HDL Ratio value in Group 1 (2.37 ± 0.62) was significantly lower than Group 2 (3.35 ± 1.03) as per Student t-test (p<0.05).

Table 7: Comparison of Lipid Profile parameters of subjects

Parameters		Group 1		Group 2		P Value
		N	%	N	%	
Total Cholesterol (mg/dl)	<200	66	74.2%	58	65.2%	< 0.05
	≥200	23	25.8%	31	34.8%	
	Total	89	100%	89	100%	
	Mean±SD	172.75 ± 34.57		183.28 ± 43.76		
Triglycerides (mg/dl)	<150	72	80.9%	50	56.2%	< 0.05
	≥150	17	19.1%	39	43.8%	
	Total	89	100%	89	100%	
	Mean±SD	109.56 ± 30.20		139.78 ± 23.52		
LDL (mg/dl)	<100	44	49.4%	27	30.3%	< 0.05
	≥100	45	50.6%	62	69.7%	
	Total	89	100%	89	100%	
	Mean±SD	97.97 ± 16.03		120.62 ± 28.60		
HDL (Males) (mg/dl)	<40	15	16.8%	32	35.9%	< 0.05
	≥40	34	38.3%	15	16.9%	
	Total	49	55.1%	47	52.8%	
	Mean±SD	44.02 ± 8.55		38.17 ± 7.37		
HDL (females) (mg/dl)	<50	33	37.1%	41	46.1%	< 0.05
	≥50	7	7.8%	1	1.1%	
	Total	40	44.9%	42	47.2%	
	Mean±SD	42.50 ± 13.34		36.14 ± 6.80		
VLDL (mg/dl)	<38	83	93.3%	70	78.7%	<0.05
	≥38	6	6.7%	19	21.3%	
	Total	89	100%	89	100%	
	Mean±SD	23.56 ± 7.85		31.57 ± 7.40		
TG/HDL Ratio	<3.5	74	83.2%	31	34.8%	<0.05
	≥3.5	15	16.8%	58	65.2%	
	Total	89	100%	89	100%	
	Mean±SD	2.65 ± 0.89		3.86 ± 0.85		
LDL/HDL Ratio	<2.5	73	57.3%	16	17.9%	<0.05
	≥2.5	38	42.7%	73	82.1%	
	Total	89	100%	89	100%	
	Mean±SD	2.37 ± 0.62		3.35 ± 1.03		

DISCUSSION

A hospital based cross sectional case control study was conducted with 178 subjects to evaluate the role of lipid profile in prediabetics.

In the present study the mean age of the subjects in group 1 was 50.92 ± 12.42 years whereas mean age of the subjects in group 2 was 50.30 ± 12.64 years. There was no significant difference between the groups as per Student t-test (p>0.05). There were 49 (55.1%) and 47 (52.8%) male subjects in Group 1 and Group 2 respectively while female subjects constituted 44.9% and 47.2% of the study groups respectively. There was no significant difference between the groups as per Fisher test (p>0.05).

In our study, 36 (40.5%) subjects in Group 1 were in the normal range while 45 (50.6%) and 8 (8.9%) subjects were overweight and obese respectively. The mean BMI of subjects in Group 1 was 25.58 ± 3.25kg/m2. 34 (38.2%) subjects in Group 2 were in the normal range while 46 (51.7%) and 9 (10.1%) subjects were overweight and obese respectively. The mean BMI of subjects in Group 1 was 25.80 ± 3.43kg/m2. There was no significant difference between the groups as per Student t-test test (p>0.05). This is similar to the study of Bhowmik B et al11.Bhowmik B et al population-based cross-sectional study investigating serum lipids and their association with glucose intolerance status (T2DM and prediabetes) found participants with prediabetes

and T2DM were older, more obese (both general and central obesity) and were more hypertensive than the NGT group.[11]

It was observed in the present study that the SBP and DBP values of subjects in Group 1 (120.31±12.51mmHg and 76.51±9.89mmHg) were comparable to SBP and DBP values of subjects in Group 2 (121.24±11.79mmHg and 77.17± 8.35mmHg). This difference was statistically not significant as per Student t-test ($p>0.05$).The FBS and PPBS values of subjects in Group 1 were significantly lesser (93.77±15.47mg/dl and 121.79±11.29mg/dl) as compared to FBS and PPBS values of subjects in Group 2 (112.52±16.40mg/dl and 177.23±17.31mg/dl). This difference was statistically significant as per Student t-test ($p<0.05$). This is consistent with the study of Bhowmik B et al,[11] except for hypertension which was not significant.

The mean Total Cholesterol value in Group 1 (172.75 ± 34.57mg/dL) was significantly lower than Group 2 (183.28 ± 43.76mg/dL) as per Student t-test ($p<0.05$). The mean Triglyceride value in Group 1 (109.56 ± 30.20mg/dL) was significantly lower than Group 2 (139.78 ± 23.52mg/dL) as per Student t-test ($p<0.05$). The mean LDL value in Group 1 (97.97 ± 16.03mg/dL) was significantly lower than Group 2 (120.62 ± 28.60mg/dL) as per Student t-test ($p<0.05$). This is comparable to the studies of, Bhowmik B et al,[11] Kansal S et al,[12] Williams DE et al,[13] Gaziano JM et al,[14] Balgi V et al,[15] RahbarS et al,[16] Magge SN et al,[17] Miyazaki Y et al,[18] Shin JY et al,[19] and Hussain KSA et al.[20]

In our study, the mean HDL value in male patients of Group 1 (44.02 ± 8.55mg/dL) was significantly higher than male patients of Group 2 (38.17 ± 7.37mg/dL) as per Student t-test ($p<0.05$). The mean HDL value in female patients of Group 1 (42.50 ± 13.34mg/dL) was significantly higher than female patients of Group 2 (36.14 ± 6.80mg/dL) as per Student t-test ($p<0.05$). The mean VLDL value in Group 1 (23.56 ± 7.85mg/dL) was significantly lower than Group 2 (31.57 ±7.40 mg/dL) as per Student t-test ($p<0.05$). This is concordant to the studies of Kansal S et al,[12] Balgi V et al,[15] and Shin JY et al.[19]

In the present study, the mean TG/HDL Ratio value in Group 1 (2.65 ± 0.89) was significantly lower than Group 2 (3.86 ± 0.85) as per Student t-test ($p<0.05$). The mean LDL/HDL Ratio value in Group 1 (2.37 ± 0.62) was significantly lower than Group 2 (3.35 ± 1.03) as per Student t-test ($p<0.05$). Similar observations were noted in the studies of Bhowmik B et al,[11] Miyazaki Y et al,[18] and Kansal S et al.[12] Miyazaki Y et al,[18] reported that IFG/IGT patients had higher TG/ HDL ratio (4.0 ± 2.5 for cases and 2.7 ± 1.9 for controls). There was no critical distinction for LDL/HDL proportion between case subject and control subjects. These outcomes recommended that increase of postprandial levels of plasma glucose and insulin based on entire body insulin resistance added to atherogenic lipids profile.

CONCLUSION

Lipid profile in prediabetic subjects including Total cholesterol, TG, TG/HDL ratio and LDL/HDL ratio are remarkably raised compared to normal healthy subjects and HDL cholesterol is lower than normal subjects. These individuals are high risk for development of cardiovascular diseases. Early intervention in the form of lifestyle modification and pharmacological therapy can prevent cardiovascular complication in these cases.

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