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A study of prevalence of pre-diabetes and cardio-metabolic risk factors in first degree relatives of patients with type-II diabetes mellitus

Arcot Krishna Kishore[1], Sreeram Praveen[2*], Sandeep Rai[3]

[1]*Sr. Resident, Department of General Medicine, MGM Institute of Health Sciences, Kamothe, Navi Mumbai, India*
[2]*Jr. Resident, Department of General Medicine, MGM Institute of Health Sciences, Kamothe, Navi Mumbai, India*
[3]*Professor, Department of General Medicine, MGM Institute of Health Sciences, Kamothe, Navi Mumbai, India*

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Abstract
Background: Diabetes mellitus encompasses a range of heterogeneous metabolic disorders characterized bythe inability of the body to assimilate glucose and maintain glucose homeostasis. **Aims and Objectives:** To find out the prevalence of Prediabetes and Cardio metabolic risk factors in first degree relatives of patients with Type2DM. **Material and Methods:** This cross-sectional, observational study was conducted in the Department of Medicine and Department of Biochemistry, MGM Medical College and Hospital, Navi Mumbai. A total of 100 first degree relatives of patients suffering from Type 2 DM included in the study. **Results:** The prevalence of Prediabetes amongst the first degree relatives of Type 2DM was found to be 26%. The prevalence of cardio metabolic risk factors observed amongst the first degree relatives of patients of Type 2 DM were: history of CVD in 12%, Over weight by BMI in 73%, Overweight by WHR in 54%, Hypertension in32%, Dyslipidemiain 47%. The prevalence of Prediabetes was found to be more in the first degree relatives of diabetes patients who were overweight (by BMI) (32.88%) than those first degree relatives with the normal weight(by BMI) (7.41%). The prevalence of Prediabetes was more in the first degree relatives of Type 2diabetes patients who were Overweight (by WHR) (37.04%) than the first degree relatives with the normal weight (byWHR) (13.04%). The mean BMI and WHR was higher in the first degree relatives of Type2 diabetes patients with Prediabetes. The mean levels of LDL and TG were higher and mean HDL was lower in the first degree relatives of Type2 diabetes patients with Prediabetes. The mean levels of FBS and PLBS was higher in the study population with Prediabetes amongst the first degree relatives of Type2 DM. **Conclusion:** In the present scenario of rising worldwide incidence of Diabetes, identifying the risk factors which can be amenable to prevention is important, as Diabetes increases the risk of both microvascular and macrovascular complications contributing to increased morbidity and mortality in diabetic patients. Besides increasingly prevalent sedentary lifestyle in our general population, rampant adoption of western culture including increasing intake of fast food added with the underlying genetic predisposition is alsomaking the people in general more obese and insulin resistant thus contributing to rapidly increasing incidence of diabetes in our country. It was concluded from the present study that first degree relatives of patients withType2DM patients have high prevalence of prediabetes and other cardio metabolic risk factors.
Keywords: Prevalence, Pre-diabetes, Cardio-metabolic, Riskfactors, First degreeType-IIdiabetes mellitus.

Introduction
Diabetes refers to a group of metabolic diseases characterized by hyper glycemia resulting from defect sin insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels. Diabetes encompasses a range of heterogeneous metabolic disorders characterized by the inability of the body to assimilate glucose and maintain glucose homeostasis. Diabetes has been traditionally subdivided into: Type 1 DM or Insulin-dependent DM and Type2 DMor Non-Insulin Dependent DM[1].

According to the International Diabetes Federation, approximately 415million people were suffering from diabetes worldwide, and this number is expected to exceed 640million by the year 2040[2]. It is estimated that half of patients with diabetes are unaware of their disease and are thus more proneto developing diabetic complications. Type2 DM has become an observably global public health problem.

*Correspondence
Dr. Sreeram Praveen
Jr. Resident, Department of General Medicine, MGM Institute of Health Sciences, Kamothe, Navi Mumbai, India.
E-mail: rram204947@gmail.com

This is because firstly, diabetes is on a steady increase in developed countries, such as United States and Japan. And it is worthy of note that Type 2 DM has become a serious issue at an alarming rate in developing countries. Seven out of top ten countries with the largest number of diabetes patients are lower middle-income countries, including India, China, Russia, Brazil, Pakistan, Indonesia, and Bangladesh[3], among which the prevalence rate sare 12.1% and 9.7% in India and China, respectively[4,5]. Secondly, although advancing age is a risk factor for Type 2 DM, rising rates of childhood obesity have resulted in Type2 DM becoming more common in children, teen agers and adolescents, which is a serious emerging of the epidemic and a new public health problem of significant proportions[6].

There is a high prevalence of pre-diabetes in relatives of type-2 diabetes mellitus patients observed in many western studies. There are only few Indian studies done on this topic. The prevalence of Diabetes is on rise worldwide. Type 2 DM is the more prevalent form of Diabetes. Research indicates that in addition to the lifestyle factors, there is a significant genetic predisposition amongst the cases of Type 2 DM, as evidenced by higher risk with positive family history and concordance at in twins. Recently, it has also been realized that the Diabetes and cardiovascular diseases may have interlinked under lying mechanism, in addition to multiple common risk factors. Pre diabetes is a serious health condition where blood sugar levels are higher than normal, but not high enough yet to be diagnosed as type2

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diabetes. The cardio metabolic risk factors are those factors which increase the risk of cardio vascular disease. The cardio merabolic risk factors are smoking, hypertension, obesity, dyslipidemia, previous history of cardio vascular disease.

Therefore, this study was conducted to assess the prevalence of Prediabetes and cardio metabolic risk factors in the first degree relatives of patients having Type2 DM and to further assess(i) glycemic parameters, Fasting blood glucose, Post prandial blood glucose, HbA1C, cardio metabolic risk factors, lipid profile, Height, Weight, Waist circumference, Hip circumference, Waist: Hipratio and BMI and supine blood pressure.

Materials and method

This cross-sectional, observational study was conducted in the Department of Medicine and Department of Biochemistry, MGM Medical College and Hospital, Navi Mumbai. Prior approval of Institutional Ethics Committee was taken before start of the study. A written signed informed consent was taken from the parents/ guardians prior to enrolling the subjects in the study. Present study was carried out from December 2018–October 2020. A total of 100 first degree relatives of patients suffering from Type 2 DM met the inclusion and exclusion criteria.

Inclusion Criteria

1. First degree relatives (Father/ mother/ brothers/ sisters /sons /daughters) of known TypeII DM patients, above the age of 30 years.
2. First-degree relatives who are not known cases of diabetes.

Exclusion Criteria

1. First degree relatives of known TypeII DM patients, below the age of 30years.
2. Relatives, other than first degree relatives.
3. Adopted sons/daughters of TypeII DM patients.
4. First degree relative who is a known case of diabetes.
5. First degree relative who is diagnosed with Hypothyroidism, Nephrotic syndrome, liver disease or is on oral contraceptive pills, thiazides, glucocorticoids or beta blockers.
6. Pregnant women.
7. Participants who do not give consent to participate in the study.

Sample size

As per studies conducted in Indian population the prevalence of glucose intolerance in first degree relatives of Type 2 DM patients is 12%. With confidence interval of 95% and 5% permissible error, sample size comes out to be 110cases. However, as this was a time bound study, 100 first degree relatives of Type 2 DM patients who attended the OPD or are admitted in the Medicine Ward during the study period, were be taken for the study.

All first degree relatives of Type2 DM patients who attended the OPD or were admitted in the Medicine Ward during the study period and who met the inclusion and exclusion criteria, were included in the study. Prior approval of the Institutional Ethics Committee was taken before conducting the study.

Method of data collection

All first degree relatives of Type2 DM patients who attended the OPD or were admitted in the Medicine Ward during the study period were included in the study, provided they met the inclusion and exclusion criteria as above. In the first visit, the Type2 DM patients visiting the Diabetic Clinic, were identified and explained the purpose of the study and the importance of this study for attaining better health of their relatives. Relatives were called with the index patient in their next visit. All the first degree relatives meeting the inclusion and exclusion criteria, were explained the purpose and methodology of the study and the importance of this study for attaining better health and preventing future diseases. They were required to sign a Consent Form. They were assured about the maintenance of confidentiality and the nature of voluntary participation.

Same methodology was applied to relatives of diabetic patients admitted in wards. Once consent was given, the patients were included in the study. A total of 100 participants were included in the study.

Materials included

1. Standard Weighing machine
2. Stadiometer for height measurement
3. Measuring tape for the estimation of waist circumference and hipcircumference
4. Sphygmomanometer for blood pressure measurement
5. Clinical biochemistry analyser (AU480byBeckmancoulter)
6. Consumables for estimation of FBS, PPBS, HbA1C and Lipid Profile

Method

Detailed personal and past history were taken from all the participants and recorded. Weight was measured by the standard weighing machine. Height was measured by the Stadiometer available in OPD. Waist circumference was measured by using measuring tape, at the midpoint of lower rib cage and anterior superior illiac spine and hipcircumference was measured at the midhipregion. BMI, Waist: hipratio was also calculated. All the parameters were recorded. The cut off for BMI was taken as $24.9 kg/m^2$ and the cut off or Waist: hip was taken as 0.90 formales and 0.85 for females. Any case having values more than the cut offs were labeled to be "Overweight".

Supine blood pressure was recorded for both arms, after 5 minutes of resting in a quietroom, and abstinence from smoking, tea and coffee for prior 2 hours. Blood pressure wastaken twice at 5 minutes interval. The average of the two readings of higher arm wasrecorded as the subject's blood pressure. The cut off for systolic blood pressure anddiastolic blood pressure were 120 mmHg and 80 mmHg. Any case having either bloodpressure more than the cut off limit of 120mm of hg systolic /80 mmHg diastolic waslabelledtohave "Hypertension".

Then, 10 ml of the blood sample was collected and the volume was divided in to fluoride (for fasting and post-lunch blood sugar), EDTA (for HbA1c) and Plain bulb(for fasting lipid profile) for further analysis. All samples were stored at 2 to 8°C until processing.

The estimation of plasma sugar was carried out by Glucose Oxidase and Peroxidase method. The estimation of Fasting Lipid Profile was carried out by Enzymatic method. All the results were recorded. Participants having abnormal values were sent for further investigation and management. The cutoffs for normal values were as follows:

1. Fasting blood sugar (FBS): upto 100mg/dL
2. Post prandial blood sugar (PPBS): upto 140mg/dL(lunch)
3. Glycated haemoglobin (HbA1c): upto 6%
4. Low density lipoprotein cholesterol (LDL): upto 129 mg/dL
5. High density lipoprotein cholesterol (HDL): 40 to 60mg/dL
6. Triglycerides (TG): 250mg/dL
7. Impaired Fasting Glucose (IFG)-Fasting blood sugar-100-125mg/dL
8. Impaired Glucose Tolerance- Postprandial blood sugar-140-200mg/dL

Any case having value of FBS between 100-125mg% was labelled to have "Impaired Fasting Glucose (IFG)". Any case having value of PLBS between 140-200 mg% was labeled to have "Impaired Glucose Tolerance(IGT)". Any case having deranged values of either LDL, HDL or TG was labeled to have "Dyslipidemia".

Statistical Analysis

The data was analyzed using statistical software (IBMSPSS, IBM Corporation, Armonk, NY, USA). Descriptive statistics: The Numerical/Continuous data were expressed as Mean±Standard Deviation and the Categorical data were expressed as Percentages. Analytical statistics: The Numerical/Continuous data were analysed by the 'Unpaired t test' and the Categorical data were analysed by the Chi square test (Fischer's exact test was used when more than 20% of the cells had valueless than 5). P value of less than 0.05 was

considered as statistically significant.
Results

Table1: Age and Pre diabetes status wise distribution of the study population

Age Groups	Pre diabetes					
	Absent		Present		Total	
	N	%	N	%	N	%
30to34	20	20%	3	3%	23	23%
35to39	27	27%	15	15%	42	42%
40to44	22	22%	6	6%	28	28%
45to49	3	3%	2	2%	5	5%
Morethan50	2	2%	0	0%	2	2%
Total	74	74%	26	26%	100	100%
Mean ±SD	37.64 ±4.67		38.54±3.72		37.87±4.45	
Range	30to57years					
Pvalue	0.233					
Statistical Significance	Not Significant					

Table 1 shows the distribution of the study population according to the age and Pre diabetes status. The prevalence of Pre diabetes was 26% and the difference with respect to age was statistically insignificant.

Table 2: Gender and Pre diabetes status wise distribution of the study population

Gender	Pre diabetes					
	Absent		Present		Total	
	N	%	N	%	N	%
Males	41	41%	18	18%	59	59%
Females	33	33%	8	8%	41	41%
Total	74	74%	26	26%	100	100%
P value	0.253					
Statistical Significance	Not significant					

The study population had 59% males, 41% females. Table2 show the distribution of the study population according to gender and Pre diabetes status. The difference with respect to gender was statistically not significant.

Table 3: Pre diabetic patients detected with Impaired Fasting Glucose (IFG)and Impaired Glucose Tolerance (IGT) tests.

Parameter	N	%
OnlyIFG	2	7.69%
OnlyIGT	2	7.69%
Both IFGandIGT	22	84.62%
TOTAL	26	100%

Table3 show the patients in study population according to the IFG and IGT status. Most of the Pre diabetic patients had both IFG and IGT. Only IGT- 7.69%, only FG- 7.69%. Both IFG and IGT-84.62%.

Table4: Presence of risk factors in patients of pre diabetes

Parameter		Pre-diabetes				Total		P value
		Absent		Present				
		N	%	N	%	N	%	
Smoking	Absent	30	30%	7	7%	37	37%	0.216
	Present	44	44%	19	19%	63	63%	
CVD	Absent	69	69%	19	19%	88	88%	0.006*
	Present	5	5%	7	7%	12	12%	
Overweight (BYBMI)	Absent	25	25%	2	2%	27	27%	0.010*
	Present	49	49%	24	24%	73	73%	
Overweight (BYWHR)	Absent	40	40%	6	6%	46	46%	0.006*
	Present	34	34%	20	20%	54	54%	
Hypertension	Absent	64	64%	4	4%	68	68%	<0.0001*
	Present	10	10%	22	22%	32	32%	
Dyslipidemia	Absent	49	49%	4	4%	53	53%	<0.0001*
	Present	25	25%	22	22%	47	47%	

Table 4 shows the distribution of the risk factors. All the risk factors were significantly associated with Pre diabetes except Smoking.

Table 5: Distribution of the examination findings/ lab investigations in the study population

Parameter	Pre-diabetes		Total		P Value
	Absent	Present			
Systolic BP (INMMHG)	120.81 ±8.56	136.15 ±9.41	124.80	±11.05	<0.0001*

Diastolic BP(INMMHG)	76.08	±7.18	88.08	±4.91	79.20	±8.49	<0.0001*
BMI(INKG/m²)	23.92	±2.43	26.13	±2.53	24.49	±2.63	<0.0001*
WHR	0.88 ±0.08		0.94 ±0.10		0.90 ±0.09		0.004*
LDL(INMG/DL)	127.69	±21.25	147.19	±27.40	132.76	±24.42	<0.0001*
HDL(INMG/DL)	44±7.60		35.92	±6.24	41.90	±8.07	<0.0001*
TG(IN MG/DL)	130.78	±27.11	152.04	±24.44	136.31	±27.94	0.001*
FBS(INMG/DL)	93.96	±4.24	111.92 ±7.69		98.63	±9.53	<0.0001*
PLBS(INMG/DL)	128.70 ±7.34		148.96	±10.11	133.97	±12.05	<0.0001*
HbA1c(IN%)	5.61 ±0.30		5.73 ±0.28		5.64 ±0.30		0.096

Table 5 shows the distribution of the examination findings/lab investigations in the study population. All the parameters of examination findings, viz. SBP, DBP, BMI and WHR, were significantly higher in the study population with Pre diabetes. Similarly, the laboratory parameters, viz, LDL, HDL, TG, FBS, PLBS and HbA1c, were higher in the study population with Pre diabetes. The difference for all the laboratory parameters were significant except HbA1c.

Discussion

The prevalence of Diabetes is on rise worldwide. Type2 DM is the more prevalent form of Diabetes. Research indicates that in addition to the lifestyle factors, there is a significant genetic predisposition amongst the cases of Type 2 DM, as evidenced by higher risk with positive family history and concordance rates in twins[7]. In the present study, the prevalence of Pre diabetes was found to be 26%.

In another study by ZhengS. Et al[8], they conducted across-sectional and prospective cohort study to assess the associations of TG, glucose and waist circumference with the prevalence of pre diabetes and diabetes in first degree relatives of Type2 DM patients. They included a total of 1544 participants were included in the study. They found the prevalence of Prediabetes to be 27.34%. This was similar to the present study. MeamarR. Et al[9] conducted a study to evaluate these verity of the metabolic syndrome as a predictor of prediabetes and Type2 DM in first degree relatives of Type2 DM patients. This 15 year long prospective study included a total of 1766 first degree relatives of Type2 DM patients. 714 participants were lost to follow up. They finally analysed a total of1052 first degree relatives. They found the prevalence of Prediabetes at the end of the 15year study was 32.6%. This was almost similar to the present study. Thus, it can be concluded that the prevalence of Prediabetes in the first degree relatives of Type2 DM patients is around 26%.

Age and gender distribution

In the present study, the mean age of the study population was 37.87 ± 4.45 years. The mean age of the study population affected with Pre diabetes was 38.54±3.72years. The mean age of the unaffected population was 37.64±4.67 years (P value:0.233). In the present study, it was also observed that males (30.51%) were more affected than the females (19.51%). However, the difference was not statistically significant (Pvalue:0.253).

In the study by ZhengS. Et al[8], to assess the associations of TG, glucose and waist circumference with the prevalence of prediabetes and diabetes in1544 first degree relatives of Type 2 DM patients, they found that the mean age of the population having Prediabetes (52years) was higher than the population without Prediabetes (47years)(Pvalue:<0.05). This was in contrast to the present study where the difference was statistically in significant. They also found that males(40.47%) were more affected than females(38.31%), but the difference was statistically insignificant. This was similar to the present study.

In another study by JanghorbaniM. Et al[10], 1089 non-diabetic and non-hypertensive first degree relatives of patients having Type2 DM were included to investigate the relationship between plasma glucose levels and the incidence of hypertension. They found that the mean age was more in the population with IGT (43.3 years) than in the population with NGT (41.6 years)(P value: <0.001). This was different than the present study where the difference was statistically

insignificant.

Smoking and Pre diabetes

In the present study, the prevalence of smoking was found to be 63%. The prevalence of Pre diabetes was more in Smokers than in non-smokers (30.16% vs 18.92% respectively). However, the difference was statistically insignificant (Pvalue: 0.216). In the study by MeamarR.etal[9], they included a total of 1052 first degree relatives of Type 2 DM patient. They found that no statistically significant difference in the prevalence of smoking in the population having Pre diabetes and the population without Pre diabetes (Pvalue:0.88). Thus, it can be concluded that smoking is not associated with Pre diabetes in the first degree relatives of Type2 DM patients.

Cardiovascular Disease and Pre diabetes

In the present study, the prevalence of CVD was 12%. It was also observed that the prevalence of Pre diabetes was more in cases having CVD(58.33%) than in cases without CVD(21.59%). The difference was statistically significant (Pvalue:0.006).

Over weight and Pre diabetes

In the present study, over weight was assessed by two methods: by BMI (Quetletindex) and by WHR. When assessed by BMI, the prevalence of overweight in the study population was found to be73%. It was also observed that the prevalence of Pre diabetes was more in the overweight population (32.88%) than in the non-overweight population (7.41%) and the difference was found to be statistically significant Pvalue:0.010). Also, the mean BMI of the population having Pre diabetes (26.13 ± 2.53 kg/m²) was more than the population without Pre diabetes (23.92 ± 2.43 kg/m²). And the difference was found to be statistically significant (Pvalue:<0.0001).

When assessed by WHR, the prevalence of overweight in the study population was found to be 54%. It was also observed that the prevalence of Pre diabetes was more inthe overweight population (37.04%) than in the non-overweight population (13.04%)and the difference was found to be statistically significant (P value: 0.006). Also, the mean WHR of the population having Pre diabetes (0.94 ± 0.10) was more than the population without Pre diabetes (0.88 ± 0.08) and the difference was found to be statistically significant(Pvalue:0.004).

In the study by Zheng S.etal[8], mean BMI of the population having Pre diabetes (25.12kg/m²) was more than the population without Prediabetes(24.39kg/m²) and the difference was found to be statistically significant (Pvalue:<0.05). This was similar to the present study.

In another study by JanghorbaniM.etal[10], 1089 non-diabetic and non-hypertensive first degree relatives of patients havingType2 DM were included to investigate the relationship between plasma glucose levels and the incidence of hypertension. Theyfound that the mean BMI and WHR were significantly more in the population with IGT(BMI:29.1kg/m²,WHR:0.83cms) than in the population with NGT(BMI:28kg/m²,WHR:0.81cms); with Pvalue of less than 0.001 for each. These trends were similar to the present study.

Hypertension and Pre diabetes

In the present study, the prevalence of Hypertension was 32%. It was also observed that the prevalence of Pre diabetes was more in hypertensives (68.75%) than in non-hypertensives (5.88%) and the

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difference was statistically significant (Pvalue:<0.0001). Also, the mean systolic blood pressure of the population having Pre diabetes (136.15±9.41mmHg) was more than the population without Pre diabetes(120.81±8.56mmHg) and the difference was found to be statistically significant (P value: <0.0001). The mean systolic blood pressure of the population having Pre diabetes (88.08±4.91 mmHg) was more than the population without Pr ediabetes (76.08±7.18mmHg) and the difference was found to be statistically significant (Pvalue:<0.0001).

In the study by Zheng S. etal[8], they also found that the mean systolic blood pressure of the population having Pre diabetes (126 mmHg) was higher than the population without Pre diabetes (121 mmHg) and the difference was found to be statistically significant (P value: <0.05). Similar was the trend with the mean diastolic blood pressure. It was higher in the population having Pre diabetes (79 mmHg) than in the population without Pre diabetes (76mmHg) and the difference was found to be statistically significant (P value: <0.05). These findings were similar to the present study.

These findings were similar to the present study. In the study by GholiZ.etal[11], they studied the characteristics of pre-diabetic patients associated with body composition and cardiovascular disease risk factors in the Iranian population. They included 193 Pre diabetic first degree relatives and 193 age and gender matched controls (also first degree relatives) from the Isfahan Diabetes Prevention Study (IDPS), a prospective cohort study. They observed that the mean systolic and diastolic blood pressures were higher in the Pre diabetic cases (SBP:115.26±16.07mmHg, DBP:78.36±12.11mmHg) than in the controls (SBP:112.79 ±13.69mmHg, DBP: 73.98 ± 12 mmHg). However, only the difference in the mean diastolic blood pressure was statistically significant (Pvalue:<0.001). These results were similar to the present study. Thus, it can be concluded from the present study that the mean systolic and diastolic blood pressures are higher in the population with Pre diabetes amongst the first degree relatives of Type2 DM.

Dyslipidemia and Pre diabetes
In the present study, the prevalence of dyslipidemia was 47%. It was also observed that the prevalence of Pre diabetes was more in the population having dyslipidemia (46.81%) than in the population without dyslipidemia (7.55%). And the difference was statistically significant (Pvalue:<0.0001). When assessed in terms of LDL and TG, it was observed that the values of mean LDL and TG were higher in the population having Pre diabetes (LDL:147.19±27.40mg/dL,TG:152.04±24.44mg/dL) than in the population without Pre diabetes (LDL: 127.69±21.25mg/dL,TG:130.78±27.11mg/dL) and the difference was found to be statistically significant (P value: LDL: <0.0001, TG: 0.001). When assessed in terms of HDL, it was observed that the mean HDL was less in the population having Pre diabetes (35.92 ± 6.24 mg/dL) than in the population without Pre diabetes (44 ± 7.60 mg/dL). And the difference was found to be statistically significant (Pvalue:<0.0001).

In the study byZhengS.etal[8], values of mean LDL and TG were higher in the population having Pre diabetes (LDL: 3.03 mmol/L, TG: 1.71 mmol/L) than in the population without Pre diabetes (LDL:2.93mmol/L,TG:1.33mmol/L) and the difference was found to be statistically significant (Pvalue:<0.05). It was also observed that the mean HDL was less in the population having Pre diabetes (1.31mmol/L) than in the population without Pre diabete s(1.47mmol/L). And the difference was found to be statistically significant (P value: <0.05). These findings were exactly similar to the present study. In the study by MeamarR.etal[9], a total of 1052 first degree relatives of patients having Type 2 DM were studied. They found that the mean TG was higher in the population having Pre diabetes (157.78±81.03mg/dL) than in the population without Pre diabetes(146.3 ± 81.1 mg/dL). And the difference was statistically significant (P value: 0.03).This was similar to the present study.

Thus, it can be concluded from the present study that the mean levels of LDL and TG are higher and mean HDL is lower in the population with Pre diabetes amongst the first degree relatives of Type2 DM.

Blood sugar and Pre diabetes
In the present study, it was observed that out of the population having Pre diabetes, 7.69% had only IFG and only IGT, each, while majority of the cases (84.62%) had both IFG and IGT. When assessed in terms of FBS and PPBS, it was found that the values of mean FBS and PPBS were higher in the population having Pre diabetes (FBS:111.92±7.69mg/dL, PPBS:148.96 ± 10.11 mg/dL) than in the population without Pre diabetes (FBS: 93.96 ± 4.24mg/dL, PLBS: 128.70 ± 7.34 mg/dL). And the difference was found to be statistically significant (P value: <0.0001 for both FBS and PPBS). But when assessed in terms ofHbA1c, it was found that the values of mean HbA1c were almost similar in the population having Pre diabetes(5.73±0.28%) and the population without Prediabetes (5.61 ± 0.30%) and the difference was not statistically significant (Pvalue:0.096). In the study by ZhengS.etal[8], they assessed the associations of TG, glucose and waist circumference with the prevalence of pre diabetes and diabetes in first degree relatives of Type 2 DM patients. They included a total of 1544 first degree relatives of Type 2 DM patients. They found that the mean FBS, PLBS and HbA1c were higher inthe population with Pre diabetes (FBS: 5.74 mmol/L, PPBS: 8.65 mmol/L, HbA1c:5.75%) than in the population without Pre diabetes (FBS: 5.10 mmol/L, PPBS: 6.06mmol/L, HbA1c: 5.50%). All the differences were statistically significant. This was similar to the present study, except the difference between HbA1c was statistically insignificant.

In the study by MeamarR.etal[9], prevalence of IFG at the end of the study period of 15 years, was 24.1% and the prevalence of IGT was 8.4%. They also found that the mean FBS was higher in the population having Pre diabetes(89.69±6.9mg/dL) than in the population without Pre diabetes (87.05±7.91 mg/dL) and the difference was statistically significant (Pvalue:0.001). They also found that the mean PLBS was higher in the population having Pre diabetes (104.2±21.36mg/dL) than in the population without Pre diabetes(97.81±21.05mg/dL) and the difference was statistically significant (P value: 0.001). These results were similar to the present study. In terms of mean HbA1c, they found that the population with Pre diabetes had higher mean HbA1c (5.06 ± 0.7%) than the population without Pre diabetes (4.92±0.78%); with a statistically significant difference (P value: 0.009). This was different from the present study where the difference was statistically insignificant.

Conclusion
In the present scenario of rising worldwide incidence of Diabetes, identifying the risk factors which can be amenable to prevention is important, as Diabetes increases the risk of both microvascular and macrovascular complications contributing to increased morbidity and mortality in diabetic patients. Besides increasingly prevalent sedentary lifestyle in our general population, rampantad option of western culture including increasing intake of fast food added with the underlying genetic predisposition is also making the people in general more obese and insulin resistant thus contributing to rapidly increasing incidence of diabetes in our country. It was concluded from the present study that first degree relatives of patients with Type2 DM patients have high prevalence of pre diabetes and other cardio metabolic risk factors. The prevalence of Pre diabetes amongst the first degree relatives of Type2 DM was estimated to be26% in the present study. Thus, the first degree relatives of Type 2 DM patients form the high risk group for targeted interventions for both prevention and diagnosis of diabetes and cardiovascular diseases.

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