Original Research Article

A study on serum lipid profile in obese prediabetics

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Abstract

Background: Prediabetes is well-known to be a significant risk factor for type 2diabetes as well as heart disease and other chronic conditions. The pattern of multi-system involvement in prediabetes is similar to that of diabetic neuropathy. The purpose of this study was to determine the trend in fasting lipids in obese prediabetics who were obese at baseline. **Objective:** Obese patients with prediabetes were studied for their serum lipid profile. **Materials and Methods:** According to the inclusion criteria, this is a prospective case-control research with 40 patients and 40 controls who were admitted to GovtMedical College, Suryapet over 18 months. All of the pertinent information was gathered, and the variables were then examined using the t-test and the chi-square test. **Results:** Compared to the controlgroup, the mean total cholesterol in the case group was 168.26, which was greater than the control group's 189.24. Triglycerides averaged 176.84mg/dl in the control group of obese patients, whereas they averaged 190.44mg/dl in the obese prediabetic group. However, LDL cholesterol was on the rise. Individuals with prediabetes had a haemoglobin A1C of 115.66, compared to 145.66 in the control group. A higher HDL cholesterol level of 40.34 was found in the control group, compared to a lower HDL cholesterol level of 35.68 in the case group, according to this study. Interestingly, there was no statistically significant difference in VLDL levels across the groups in this investigation. It was discovered that the control group had a mean VLDL of 31.3432. Individuals with obesity and pre- diabetes had a VLDL. Furthermore, when compared to FBS, it was discovered that HbA1c alone was not a sufficient technique for detecting dyslipidemia **Conclusion:** According to the findings of this study, all serum lipid markers, except for HDL-c, are considerably raised in prediabetic obese patients.Because of their dyslipidemic status, these prediabetic obese adults are at an increased risk of developing cardiovascular disease in the future.

Keywords: Obese, Lipid Profile, Dyslipidemia, prediabetic, dyslipidemic.

Introduction

Diabetes Mellitus is a global epidemic emerging as a major burden on health care systems. Three hundred and forty-seven million people worldwide have diabetes. The complications of Diabetes and its impact on quality of life has been extensively studied. The effects of raised blood glucose on other metabolic parameters and pathways are being actively researched[1, 2].

Its precursor Prediabetes is close behind and needs to be extensively evaluated for its associations with other co-morbidities. The global prevalence of prediabetes has been increasing progressively in the past few decades. There is a school of thought that the incidence of prediabetes is higher than that of type 2 diabetes mellitus. It has been established that prediabetes is a strong risk factor for overt DM and cardiovascular disease.As expected, prediabetes also follows a similar pattern concerning multi-system involvement[3].

We tend to focus on the impact of high normal sugars in obese individuals, particularly on the fasting lipid profile. Our observations are aimed at deriving a relationship between prediabetes sugars and lipid parameters in obese individuals and hence conclude the cumulative effect of these three risk factors in cardiovascular diseases.

Objectives

1) To study the serum lipid profile in prediabetic individuals who are obese

Materials and methods

Source of data

The study included both outpatients and inpatients of Govt Medical College & Hospital.

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Method of collection of data

Study design

A prospective case-control study spanning 18 months beginning September 2020 involvinga sample size of a minimum of 40 cases and 40 controls with age and sex match.

Study protocol

Fasting blood glucose or glycated haemoglobin was done for obese patients on both outpatient and inpatient basis followed by a fasting lipid profile. Analysis of the lipid profile derangements in subjects participating in the study was carried out.

Inclusion Criteria

1. Patients in the age group of 18-65.
2. Patients with a BMI of 25kg/m^2 or more.
3. Patients with a fasting blood glucose between 100 and 125 (both included)and anHbA1C of 5.7 to 6.4 (both included).

Exclusion Criteria

Patients with-

1. Diabetes mellitus on insulin or oral hypoglycemics.
2. Liver diseases with deranged liver function tests.
3. Chronic kidney disease
4. Alcohol dependence
5. Pregnancy
6. Drug therapy on - lipid-lowering agents

- Oral contraceptive agents
- steroids
- thiazides
- anticoagulants

Statistical Analysis

Statistical analysis was done using Microsoft Excel 2016 and IBM SPSS version 21. Independent student T-test was used to compare cases vs. controls. Case vs. control and categorical variables were

compared using the Chi-square test.

Results

Table 1: Comparison of the means of different variablesusing students t-test

	Group	N	Mean	Std. Deviation	t	df	p-Value
AGE	CONTROL	40	41.8	11.23	-1.566	95	0.0576
	CASES	40	45.22	10.121			
HEIGHT	CONTROL	40	162.22	8.504	0.212	91	0.833
	CASES	40	171.9	12.833			
WEIGHT	CONTROL	40	78.12	15.021	1.303	98	0.196
	CASES	40	84.92	9.32			
BMI	CONTROL	40	29.42	3.76	2.137	98	
	CASES	40	28.05	2.087			**0.035**
FBS	CONTROL	40	92	4.785	-13.13	85	**<0.001**
	CASES	32	109.63	6.8723			
HBA1C	CONTROL	40	5.262	0.3212	-11.82	83	**<0.001**
	CASES	28	6.057	0.27895			
TC	CONTROL	40	189.24	35.848	-3.887	98	**<0.001**
	CASES	40	168.26	38.756			
TG	CONTROL	40	176.84	85.6653	-1.953	98	**0.05**
	CASES	40	190.44	86.13709			
LDL	CONTROL	40	115.66	26.2565	-4.385	91.26	**<0.001**
	CASES	40	145.66	34.6987			
HDL	CONTROL	40	40.34	12.98132	1.865	98	0.065
	CASES	40	35.68	11.98884			
VLDL	CONTROL	40	31.3432	17.84954	0.164	98	0.87
	CASES	40	30.6543	15.9643			
TC/HDL	CONTROL	40	4.234	1.987	-3.913	98	**<0.001**
	CASES	40	6.098	2.2149			

The mean age among the control group was 41±11. years and it was 47.26±10.156 years inthe case group. Data was not significant with a p- value of 0.0576. The mean height for the control group was 162.22±8.504 cms and for the case group, it was 171.9±12.833 cms. Thep value was 0.833 and was not significant.

The mean weight among the control group was 78.12±15.021 kg and it was 84.9±9.32 kg among the case group. The p-value was 0.196 and was not significant. The mean BMI among the control group was 29.4±3.76 kg/m^2. It was 28.05±2.087 kg/m^2 in the case group, p-value being 0.035 and significant.

The mean value of FBS among the control group was 92± 4.785 mg/dl and 109.63± 6.8723 mg/dl among the case group. The p-value was <0.001 and hence was significant.

HbA1c values as expected were higher among the case group as against the control group. The mean HbA1c was 5.262±0.3212 among the control group and 6.057 ± 0.278 among the case group, with a significant p value of <0.001.

The above figure shows that the mean values of various lipid parameters were higher in the case group as compared to the control group, barring HDL cholesterol for which the control group portrayed higher values. VLDL did not show any significant difference between both study groups.

The mean total cholesterol was 189.24 in the control group whereas in the case group it was 168.26. The p value was significant (<0.001)

The mean triglyceride level among the case group was significantly higher than the control group (176.84 vs. 190.44), p value being 0.05.

The mean LDL among the control group was 115.66 and it was 145.66 among the case group. Thep value was <0.001 and significant.

HDL cholesterol had a higher mean among the control group as compared to the case group.(40.34 vs 35.68) with a p-value of 0.065.

VLDL values among case and controls were 31.3432 and 30.6543 respectively. The p- value Of the 40 controls, 26 had total cholesterol in the normal range while 14 had abnormal Total Cholesterol (TC) values. Among the case group, 19 had abnormal TC values while 21 had TC values within normal limits.

Among 40 controls, 28 had triglycerides (TG) in the normal range whereas 22 individuals had TG in the abnormal range. On the other hand, 34 cases had TG in the abnormal range and 16 in the normal range.

Of the 40 controls, 30 had low-density lipoprotein (LDL) in the abnormal range while 36 individuals had LDL above the normal value.

As far as high-density lipoprotein (HDL) was concerned, 21 individuals had higher HDL levels in the case group. Among the control group, 26 subjects had HDL values in the higherrange.

As far as very-low-density lipoproteins (VLDL) were concerned 19 individuals in the case group had a VLDL in the abnormal range with 31 individuals in the normal range. Sixteen subjects in the control group had VLDL values in the higher range and 34 subjects had normal values.

Table 2: Age wise distribution of variables in case and Control group

		AGE	N	Mean	Std. Deviation	t	df	P VALUE
CONTROL	HEIGHT	<=45 YEARS	28	162.23	7.987	- 0.128	48	0.876
		>45 YEARS	12	162.55	6.987			
	WEIGHT	<=45 YEARS	27	78.2	12.87	0.034	48	0.998
		>45	13	78.05	9.986			

		YEARS						
	BMI	<=45 YEARS	24	29.4	7.987	0.008	48	0.993
		>45 YEARS	16	29.39	2.591			
	FBS	<=45 YEARS	29	92.37	5.98	- 0.963	48	0.434
		>45 YEARS	11	93.95	5.9875			
	HBA1C	<=45 YEARS	25	5.2567	0.3245	- 0.196	48	0.847
		>45 YEARS	15	5.275	0.8754			
	TC	<=45 YEARS	27	176.4333	18.79823	- 0.674	48	0.523
		>45 YEARS	13	183.45	42.95433			
	TG	<=45 YEARS	20	166.1667	83.34588	0.939	48	0.382
		>45 YEARS	20	142.85	76.38025			
	LDL	<=45 YEARS	22	113.0333	22.989	- 1.912	48	0.068
		>45 YEARS	18	127.15	27.086			
	HDL	<=45 YEARS	26	36.5667	11.765	-2.67	48	**0.01**
		>45 YEARS	14	46	13.242			
	VLDL	<=45 YEARS	28	32.4	19.908	0.503	48	0.769
		>45 YEARS	12	29.79	14..973			
	TC/HDL	<=45 YEARS	19	5.191	1.346	1.934	48	0.0877
		>45 YEARS	21	4.3265	1.357			
CASES	HEIGHT	<=45 YEARS	23	151.82	15.783	- 0.039	47	0.9887
		>45 YEARS	17	181.96	10.305			
	WEIGHT	<=45 YEARS	26	86.18	9.022	0.878	48	0.387
		>45 YEARS	14	73.89	7..251			
	BMI	<=45 YEARS	26	28.21	6.319	0.353	48	0.876
		>45 YEARS	14	28	2.943			
	FBS	<=45 YEARS	21	109.05	7.699	- 2.285	35	**0.028**
		>45 YEARS	19	114.44	5.873			
	HBA1C	<=45 YEARS	15	6	3.3381	- 1.051	33	0.322
		>45 YEARS	25	6.1	1.942			
	TC	<=45 YEARS	22	287.4545	42.814	- 0.129	48	0.887
		>45 YEARS	18	208.8929	32.329			
	TG	<=45 YEARS	26	175.4091	68.685	- 0.363	48	0.786
		>45 YEARS	14	194.3929	90.085			
	LDL	<=45 YEARS	22	149.2273	32.74355	0.641	48	0.533

		>45 YEARS	18	152.8571	30.40738			
	HDL	<=45 YEARS	22	35.0909	8.6792	0.213	48	0.786
		>45 YEARS	18	36.3571	12.991			
	VLDL	<=45 YEARS	27	33.9091	16.468	1.231	48	0.232
		>45 YEARS	13	27.3571	12.241			
	TC/HDL	<=45 YEARS	22	6.336	1.5432	0.184	46.144	0.843
		>45 YEARS	18	6.453	2.827			

Among the control group, 21 were females and there were 19 males Correspondingly, there were23 females and 17 males in the study group. When HbA1c was considered as the inclusion criteria, the cases comprised of 21 females and 19 males respectively.
On the other hand, when FBS was the inclusion criteria, the cases included 19females and 21males.

Table 3: Gender wise distribution of variables in case and control group

		SEX	N	Mean	Std. Deviation	t	df	P VALUE
CONTROL	HEIGHT	M	21	163.87	5.979	5.876	47	**<0.001**
		F	19	152.87	7.106			
		M	21	88.62	12.724			
		F	19	70.55	7.741			
	BMI	M	21	30.82	5.773	2.121	27.543	**0.039**
		F	19	25.32	3.433			
	FBS	M	21	90.12	7.082	-0.1	45	0.921
		F	19	93.02	6.503			
	HBA1C	M	21	6.654	0.3434	- 0.201	31.125	0.842
		F	19	5.2724	0.23481			
	TC	M	21	172.65	37.82315	- 0.692	37	0.492
		F	19	182.2412	34.70864			
	TG	M	21	176.2857	82.78475	2.375	38	0.176
		F	19	142.7586	86.7602			
	LDL	M	21	128.8571	22.88512	0.041	35	0.968
		F	19	114.5517	28.84761			
	HDL	M	21	35	14.17745	- 1.571	39	0.123
		F	19	42.7586	11.7006			
	VLDL	M	21	36.5234	17.50034	1.54	33	0.081
		F	19	27.6138	17.44329			
	TC/HDL	M	21	5.3471	1.85929	1.234	38	0.057
		F	19	5.4817	1.2789			
CASES	HEIGHT	M	18	179.35	7.048	6.44	3	**<0.001**
		F	17	153.48	12.859			
							7	
	WEIGHT	M	20	78.44	7.345	7.8501	39	**<0.001**
		F	13	66.57	8.173			
	BMI	M	21	27.68	2.098	- 2.544	36	0.129
		F	19	26.58	2.032			
	FBS	M	21	112.57	8.041	0.719	35	0.418
		F	16	130.5	7.014			
	HBA1C	M	19	6.32	0.24721	0.992	33	0.329
		F	16	6.0063	0.31298			
	TC	M	20	225.5556	40.38596	1.2459	38	0.151
		F	15	194.986	35.71406			
	TG	M	21	192.6296	79.64013	1.793	39	0.848
		F	19	187.8696	94.95755			
	LDL	M	21	152.6667	31.14359	1.547	36	0.123
		F	19	137.4348	37.46856			
	HDL	M	21	32.8.7778	7.77735	-1.545	32	0.59
		F	19	36.7391	15.6995			
	VLDL	M	21	30.2593	14.09744	- 1.758	36	0.798
		F	19	31.4348	18.11535			
		M	21	6.4324	1.4102			
	TC/HDL				7	1.1321	39	0.264
		F	19	5.2387	2.1932			

Table 4 and 5: Chi square tests for the assessment of the groups ofnormal andabnormal

		CONTROL		CASES	
		Count	Count N%	Count	Count N%
SEX	F	21	58.0%	23	43.0%
	M	19	42.0%	17	44.0%
TC	<=200	28	72.0%	21	42.0%
	>200	12	28.0%	19	58.0%
TG	<=150	26	56.0%	16	32.0%
	>150	14	44.0%	14	68.0%
LDL	<=100	18	20.0%	14	8.0%
	>100	22	80.0%	16	92.0%
HDL	>=35	18	52.0%	11	42.0%
	<35	22	48.0%	19	58.0%
VLDL	<=34	29	68.0%	21	62.0%
	>34	19	32.0%	19	38.0%
TC/HDL	0-4	16	36.0%	8	10.0%
	>4	26	64.0%	32	90.0%

The table on the previous page depicts the trend of lipid parameters when HbA1c and FBSwere taken as inclusion criteria separately.

It is evident that when FBS was the inclusion criteria, four out of five lipid variables were of statistically significant values. Out of these, total cholesterol, triglycerides and low density lipoprotein showed a significantly higher mean among the study group, whereas HDL cholesterol showed a statistically significant lower value among the study group.

On the other hand when HbA1c was the inclusion criteria, only two out of five lipid variables were significant. Among these, TC and LDL were significantly higher among thestudy group compared to controls.

Discussion

The study evaluated 40 cases and 40 controls meeting the selection criteria. The mean age among the control group was 41.8 years, and it was 45.22 years in the case/study group.The body mass index (BMI) had a mean value of 29.42 kg/m^2 in the control group and averaged 28.05 kg/m^2 in the case group.

The fasting blood sugar averaged 92 in the control group and had a mean value of 109.63 in the case group. The p-value was <0.001 and was significant. The HbA1c used for defining patients of interest had a mean of 5.262 in the control group as against 6.057 among the case group, p-value being significant at <0.001.

Among 40, the control group, 21 were females and there were 19 males Correspondingly, there were 23 females and 17 males in the study group

There were 22 subjects below the age of 45(inclusive) and 18 subjects who were above 45years among the cases while the control group had 19 individuals who were more than 45years of age and 21 individuals aged 45 years or less.

Analysis did not show any statistically significant elevation in lipid parameters as far as age and gender delineation was concerned.

Evaluation of the serum lipid parameters showed an elevation of total cholesterol, LDL cholesterol and serum triglycerides above normal limits even in the control group which comprised of obese normo-glycemic individuals. This lends weightage to studies carried out by Franssen R et al[4] and Wang H et al[10] who studied the impact of obesity on triglycerides and concluded that there is a positive correlation between these

Total cholesterol

The mean total cholesterol in the control group was 189.24 whereas it was higher in the case group and averaged 168.24 The p value was <0.001 and was statistically significant. Our observation was similar to earlier studies by Williams et al[5] who observed a higher mean total cholesterol in prediabetics(174.2mg/dl) when compared to normal individuals(157.5mg/dl).

Triglycerides

Triglycerides also showed significant increase in the case group compared to the controls.The mean triglycerides in the control group comprising of obese euglycaemic individuals was 176.84 mg/dl while it averaged 190.44 mg/dl among obese prediabetics. Miyazaki et al[6] also observed higher triglyceride levels in prediabetic subjects. Studies carried out by Barzi et al, Gaziano et al and Boizel et al[7,8,9] concluded that serum triglycerides were significantly higher in pre-diabetic individuals as compared to their normo-glycemic peers. Our observation of hypertriglyceridemia among the control group is in accordance with earlier studies done by Franssen R et al and Wang H et al [4,10], which they explained based on the impact of obesity on triglyceride levels.

Low density lipoproteins

The present study observed a significantly higher LDL level among the obese prediabetics as compared to normal glycemic obese individuals. While the LDL averaged 115.66 mg/dl in the latter it was 145.66 mg/dl in individuals who had prediabetes. These findings were in accordance with earlier studies by and Shin et al [11] and Magge et al[12]. Miyazaki et al [6] also observedhigher LDL cholesterol in prediabetic individuals.

High density lipoprotein

This study revealed a higher HDL cholesterol of 40.34mg/dl among the control group asagainst 35.68mg/dl among the case group. The data was not significant with a p value of 0.065. Our observations were similar to those made by Shin et al[11] and Miyazaki et al[6]. who concluded that high density lipoprotein- cholesterol was lower in prediabeticindividual.

Very low-density lipoprotein

This study did not reveal a significant difference in the levels of VLDL. A mean VLDL of 31.34 mg/dl was observed among the control group. Obese prediabetics revealed a VLDLof 30.65 mg/dl.

TC/HDL

The ratio of total cholesterol and high-density lipoprotein was found to be elevated in prediabetic obese individuals as compared to the control group comprising of obese euglycemic subjects. This is following the above-quoted studies. TC/HDL ratio was significantly elevated at 6.098 in the case group as compared to 4.234 in the control group. The p-value was significant at <0.001.

Studies from India are also on par with our observations. Kansal S and Kamble TK[36] ina similar study concluded that TC, LDL and VLDL were significantly increased in prediabetic subjects as compared to normal individuals whereas HDL was decreased among

the prediabetic subjects. Similarly, Kumar M et al[37] from the UP Rural Institute of Medical Sciences and Research, drew a conclusion that TC, LDL and TG were significantly elevated among the prediabetic individuals when compared to their normoglycemic peers. HDL was lowerin the case group as compared to the control group.

It was further also observed that HbA1c by itself was not an adequate tool for identifying dyslipidemia in the subjects studied when compared to FBS. This observation lends supportto studies by Shimodaira M et al[1] and Wu S et al[2], who concluded that HbA1c was an inadequate tool for identifying prediabetics. Also, Li J et al[3] had suggested that increasing the HbA1c threshold in prediabetic individuals remarkably improved the agreement between A1c and oral glucose tolerance test criteria in the obese population. ntities.

Limitations of the study

1) Small sample size.
2) We have included either FBS or HbA1c to define subjects of interest. Had weincluded both for all the subjects in the case group, there was a possibility of better outcome.

Conclusion

This study concludes that serum lipid parameters are significantly elevated in prediabetic obese individuals barring HDL-c which is decreased. These prediabetic obese individuals because of their dyslipidemic status are at a higher risk for developing cardiovascular disease. Screening for prediabetes and weight control hence is warranted for the well- being of the individual and more importantly for minimizing the risk of cardiovascular disease. Lifestyle modification or pharmacotherapy, thus becomes a pre-requisite and part of initialmanagement of such individuals.

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