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Study of Uric Acid and Lipid Profile in Type 2 Diabetes Mellitus Cases in Western Coastal Region of Vasai–Virar City Municipal Corporation, District - Palghar, Maharashtra, India

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Abstract

A population in the Western Coastal Region of Vasai-Virar City Municipal Corporation (VVCMC), Maharashtra, India, abounds with non- vegetarians. This study was conducted to analyze if non- vegetarian diet has the same effect on lipid profile and uric acid (UA) levels of T2DM patients of this locality as reported in internationally published data. Lipid profiles, blood sugar levels and UA in the normal controls were within the normal range. In the T2DM patients the values of cholesterol, HDL, LDL and UA were in normal range whereas the blood sugar and serum triglyceride levels were found to be elevated. The uric acid levels were lower in T2DM patients as compared to normal controls though it was in the normal range. The serum triglyceride levels were found to be on the higher side in T2DM as compared to normal controls.

Keywords: Blood Glucose, Serum Uric Acid, Type 2 DM, Western Coastal Region

1. Introduction

Diabetes Mellitus (DM) has been emerging as a major killer disease in recent times. Diabetes is a metabolic disorder which leads to severe hyperglycemia or high blood sugar levels. Type 2 diabetes mellitus, also known as Non-insulin Dependent Diabetes Mellitus (NIDDM), is caused by insulin resistance or relative lack of insulin causing severe elevation of blood glucose or blood sugar levels in the body. Lack of insulin or relatively low insulin levels affects the metabolism of carbohydrate, protein, fat, water and electrolyte balance resulting in diabetes[1].

Uric Acid (UA) is the end product of purine metabolism. The association between the blood glucose and serum uric acid levels has been known for quite some time[2]. The association of high serum uric acid with insulin resistance has been known since the early part of the 20thcentury. In individuals with an impaired glucose tolerance, an elevated Serum Uric Acid (SUA) level was found to increase the risk for developing T2DM[3]. A prospective follow-up study has shown that high serum uric acid is associated with higher risk of type 2 diabetes independent of obesity, dyslipidemia and hypertension[4]. In fact, hyperuricemia has always been presumed to be a consequence of insulin resistance rather than its precursor[5]. Elevated serum uric acid is a consistent feature of the insulin resistance syndromes, which are also characterized by elevated fasting and post-carbohydrate plasma insulin level, blood glucose concentration with serum triglyceride concentration and raised body mass index and waist-hip ratio[6,7]. India, a developing Asian country with fast industrialization and a modern lifestyle,

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is facing a grave problem in having the largest number of people with diabetes[8,9]. In type 1 diabetes no insulin is produced in the body and the body has to entirely depend on external source for insulin where as in type 2 diabetes, the body produces inadequate amount of insulin or develops insulin resistance. Type 2 diabetes is typically a chronic disease associated with a ten-year-shorter life expectancy[10]. This mainly happens due to various complications which arise after the progress of the disease. These complications include Cardiovascular Disease (CVD), renal failure, retinopathy, diabetic foot leading to amputations, etc.

Results have been described from four longitudinal and 12 cross-sectional published studies (although these results could be subject to bias) regarding the association between uric acid levels and the risk of metabolic syndrome[11]. However, the strength and the consistency of the quantitative relationship between the uric acid level and metabolic syndrome remains unclear and inconclusive[12].

To address this issue, we have performed a cross-sectional study on dyslipidemic patients to identify relationships between laboratory and anthropometric parameters connected to metabolic syndrome and uric acid levels.

However, the putative association between serum uric acid levels and diabetes mellitus is not clear. Some studies reported that there is a positive association between high serum uric acid levels and diabetes [8–14], whereas other studies reported no association or even an inverse relationship[14]. In this context, the main purpose of our study was to examine the association between serum uric acid and prevalent diabetes in a large nationally representative sample of US adults after adjusting for major confounders. We had adequate sample size to examine this association in the whole cohort as well as separately by gender and hypertension.

Although there are some reports on the relationship between SUA and diabetes from different parts of the world, still there is lack of such information for a population from Maharashtra, India. In this study, we aimed to assess the relationship between SUA, lipid and fasting blood sugar levels in non–diabetic, prediabetic and T2M individuals of Vasai-Virar area in the State of Maharashtra, India.

2. Material and Methods

2.1 Study Population

A total of 200 non-vegetarian subjects were studied from which 100 were known cases of T2DM and 100 were normal controls. Three milliliters of 12 hour fasting blood sample was collected in plain vacutainers for lipid profile and uric acid level estimation and 2 mL of blood for fasting blood glucose. After 2 hours post lunch, samples for post-prandial blood glucose estimation were collected in fluoride oxalate vacutainer.

2.2 Blood Collection and Laboratory Measurements

Before the blood sample was taken, a tourniquet (elastic) was placed tight on the upper arm. It causes blood to build up and fill the veins, so that the blood sample can easily be taken. In order to prevent bacteria, the skin was cleaned before the blood-sample was taken. After collection the samples were centrifuged at 3000 rpm for 15 to 20 min and the plasma/ serum separated and immediately analyzed on Erba Chem 5 Plus V2 Semi Automatic Analyzer.

Estimation of glucose was done by GOD/POD method. Estimation of uric acid was done by uricase / POD method**.** Estimation of cholesterol was done by CHO/POD method. Estimation of triglycerides was done by GPO/POD method. Estimation of HDL was done by direct method (POD). Estimation of LDL was done by selective detergent technique.

2.3 Diagnostic Criteria

For the present study fasting and post-prandial blood sugar, fasting UA and lipid profile levels were taken into consideration. Normal ranges for these parameters according to the test kit manual are mentioned in table below.

Table 1. Normal ranges of blood sugar, fasting UA and lipid profile

Tests	Sex	FBS	PPBS	Chol.	Tg.	HDL	LDL	UA
Normal ranges	Male	70-120	80-140	130-200	36-165	30-74	50-150	2.0-7.0
	Female	70-120	80-140	130-200	36-165	30-74	50-150	2.0-6.0

Table 2. Normal ranges of serum lipid profile according to NCEP guidelines

Cholesterol	Desirable	Less than 200 mg/dL
	Borderline	200-239 mg/dL
	High	More than 239 mg/dL
Triglycerides	Normal	Less than 150 mg/dL
	Borderline	150 - 199 mg/dL
	High	200 - 499 mg/dL
	Very high	More than 500 mg/dL
HDL	Desirable	More than 39 mg/dL
	Low	Less than 40 mg/dL
LDL cholesterol	Optimal	Less than 100 mg/dL
	Near/above optimal	100 - 129 mg/dL
	High	130-189 mg/dL

3. Results

The study was conducted on a total of 200 subjects. Of these 100 were non-diabetic and 100 T2DM patients. Among the 100 non-diabetic subjects 48 were males and 52 females while of the 100 T2DM patients 46 were males and 54 females. Table 3 shows the lipid profile, blood sugar and UA levels of normal controls. Table 4 shows the Lipid profile, blood sugar and UA values of T2DM patients. Table 5 and 6 show the values of normal control males and females, respectively, and table 7 and 8 show the values of T2DM males and females, respectively. Figures 1, 2 and 3 show comparative graph of diabetic: normal controls, normal males: female and diabetic males: females, respectively.

The values of lipid profile, blood sugar levels and UA in the normal controls were found within the normal expected range. In the T2DM patients the values of cholesterol, HDL, LDL and UA were found to be in normal range whereas the blood sugar and serum triglyceride levels were found to be elevated. It was found that the uric acid levels were lower in T2DM patients as compared to normal controls though it was in normal range. The serum triglyceride levels were found to be on the higher side in T2DM as compared to normal controls.

Table 3. Lipid profile, blood sugar and UA levels of normal controls

Sr. No.	Age	Cholesterol	Triglycerides	HDL	LDL	BSF	BSPP	Uric Acid
Sum	5000	16849.69	14143.39	3732.2	9689.7	9169	10436.98	514.03
Average	50	168.4969	141.4339	37.322	96.897	91.69	104.3698	5.1403
SD	13.21	33.79	68.8604541	9.8433	25.473	11.34	14.3952	1.54

Table 4. Lipid profile, blood sugar and UA values of T2DM patients

Sr. No.	Age	Cholesterol	Triglycerides	HDL	LDL	BSF	BSPP	Uric Acid
SUM	5608	16601.74	17040.59	3824	8969	13405	17860.3	469.97
Average	56.08	166.01 166.0174	170.41	38.24	89.69	134.1	178.60	4.70
SD	10.85	42.52	104.24	15.35	28.57	47.14	67.60	1.47

Table 5. Values of lipid profiles, blood sugar and UA values of normal control males

Sr. No	Age	Cholesterol	Triglycerides	HDL	LDL	BSF	BSPP	Uric Acid
Total	2407	8186.9	7746.14	1802.72	4782.33	4536.36	5123.81	291.21
Average	50.14	170.56	161.37	37.55	99.63	94.50	106.74	6.06
SD	13.47	35.17	79.86	10.37	27.36	12.37	15.48	1.31

Table 6. Values of lipid profiles, blood sugar and UA values of normal control females

Sr. No	Age	Cholesterol	Triglycerides	HDL	LDL	BSF	BSPP	Uric Acid
Sum	2593	8662.79	6397.25	1929.48	4907.38	4632.74	5313.17	222.82
Average	49.86	166.59	123.02	37.10	94.37	89.09	102.17	4.28
SD	13.10	32.69	51.05	9.42	23.57	9.70	13.08	1.21

Table 7. Values of lipid profiles, blood sugar and UA values of T2DM males

Sr. No.	Age	Cholesterol	Triglycerides	HDL	LDL	BSF	BSPP	Uric Acid
Total	2497	7456.92	8986.89	1730.88	4068.77	6298.72	8683.81	233.09
Average	54.28	162.10	195.36	37.62	88.45	136.92	188.77	5.06
SD	9.15	41.57	130.80	10.27	24.09	46.78	70.79	1.40

Table 8. Values of lipid profiles, blood sugar and UA values of T2DM females

Sr. No.	Age	Cholesterol	Triglycerides	HDL	LDL	BSF	BSPP	Uric Acid
Sum	3111	9144.82	8053.7	2092.97	4899.8	7106.66	9176.49	236.88
Average	55.55	169.34	149.14	38.75	90.73	131.60	169.93	4.38
SD	11.97	43.42	69.03	18.70	32.06	47.75	64.13	1.46

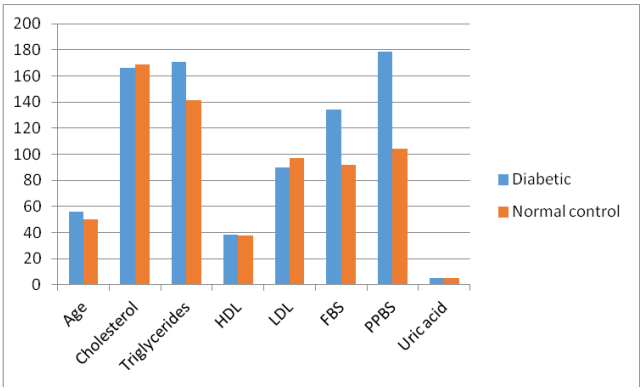

Figure 1. Graphical representation of diabetic: normal control values.

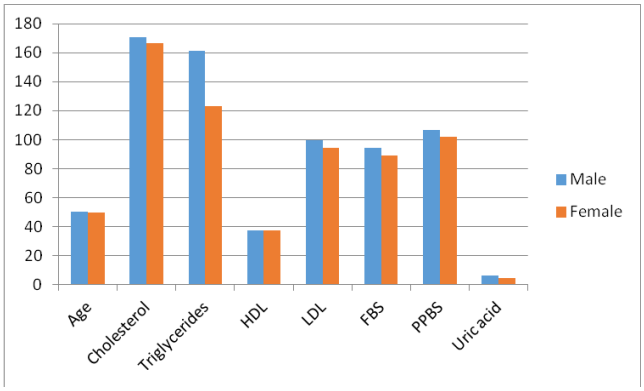

Figure 2. Graphical representation of normal control males: normal control female values.

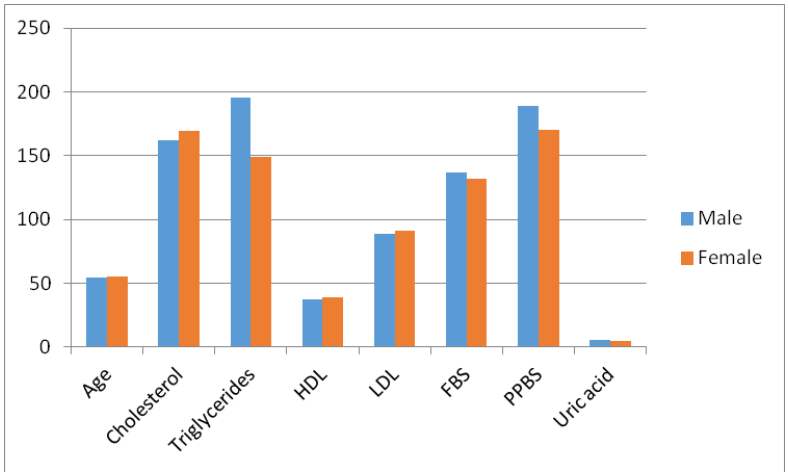

Figure 3. Graphical representation of diabetic males: diabetic female values.

Statistical Analysis

Correlation

		Age	Cholesterol	Triglycerides	HDL	LDL	BSF	BSPP	Uric Acid
Age	Pearson Correlation	1	.022	-.018	.083	-.024	.083	.062	-.049
	Sig. (2-tailed)		.752	.803	.243	.731	.245	.380	.489
	N	200	200	200	200	200	200	200	200
Cholesterol	Pearson Correlation	.022	1	.323**	.301**	.830**	.154*	.044	.155*
	Sig. (2-tailed)	.752		.000	.000	.000	.030	.540	.029
	N	200	200	200	200	200	200	200	200
Triglycerides	Pearson Correlation	-.018	.323**	1	.143 *	.324**	.255**	.297**	.218**
	Sig. (2-tailed)	.803	.000		.043	.000	.000	.000	.002
	N	200	200	200	200	200	200	200	200
HDL	Pearson Correlation	.083	.301**	.143*	1	.379**	-.142*	-.079	.030
	Sig. (2-tailed)	.243	.000	.043		.000	.045	.268	.677
	N	200	200	200	200	200	200	200	200
LDL	Pearson Correlation	-.024	.830**	.324**	.379**	1	.080	.003	.125
	Sig. (2-tailed)	.731	.000	.000	.000		.262	.968	.078
	N	200	200	200	200	200	200	200	200
BSF	Pearson Correlation	.083	.154*	.255**	-.142*	.080	1	.815**	-.141*
	Sig. (2-tailed)	.245	.030	.000	.045	.262		.000	.047
	N	200	200	200	200	200	200	200	200
BSPP	Pearson Correlation	.062	.044	.297**	-.079	.003	.815**	1	-.187**
	Sig. (2-tailed)	.380	.540	.000	.268	.968	.000		.008
	N	200	200	200	200	200	200	200	200
Uric Acid	Pearson Correlation	-.049	.155*	.218 **	.030	.125	-.141*	-.187**	1
	Sig. (2-tailed)	.489	.029	.002	.677	.078	.047	.008	
	N	200	200	200	200	200	200	200	200

**. Correlation is significant at 0.01 level (2-tailed).

*. Correlation is significant at 0.05 level (2-tailed).

Interpretation

Hypothesis I

H_0 **-** There is no relationship between BSPP and uric acid

H_1 – There is relationship between BSPP and uric acid

Hypothesis II

H_0- There is no relationship between BSF and triglycerides

H_1 – There is relationship between BSF and triglycerides

Outcome of Statistical Test

*H0 is rejected in both hypothesis I and hypothesis II

*There is a positive relationship between BSF and triglycerides

*p (value) is 0.000 < LOS (Level of significance) 0.05 and r = 25.50%

*There is negative/ inverse relationship between BSPP and uric acid

*p (value) is 0.008 < LOS 0.050 and r = -18.70%

4. Discussion

Diabetes is one of the most widely prevalent and one of the major chronic diseases in recent times. According to the World Health Organization (WHO) in November 2014, about 347 million people have diabetes worldwide. WHO estimates that in 2012, approximately 1.5 million deaths were directly caused by diabetes, and more than 80 percent of these deaths occurred in low and middle income populations.

WHO projects that by 2030, diabetes will be the seventh leading cause of death world-wide. Considering these facts, a study was undertaken in the population of Western Coastal Region of India to analyze the pattern of heart disease and to correlate the association of risk factor and diet on the progress of diabetes.

The population of West Coast is mainly non-vegetarian with a diet that includes red meat, poultry and fish products and use of tamarind juice for cooking. Since it is a coastal region, availability of fish and other non-vegetarian foods is ample.

The values of lipid profile, blood sugar levels and UA in the normal controls were found within the normal expected range. In the T2DM patients the values of cholesterol, HDL, LDL and UA were found to be in the normal range whereas the blood sugar and serum triglyceride levels were found to be elevated. It was found that the uric acid levels were lower in T2DM patients as compared to normal controls though it was in the normal range. The serum triglyceride levels were found to be on the higher side in T2DM as compared to normal controls coinciding with previous studies[11]. Although the levels of HDL-C in diabetic individuals are reportedly comparable with that found in non-diabetics, low levels of HDL-C along with elevated TG have been reported in T2DM patients as probable cause of CVD[12].

The comparison between the normal and T2DM male and female values showed that though most of the values were found to be in similar range, males had higher triglyceride and uric acid levels as compared to the females in both the cases of normal men and T2DM patients. Many studies have proved that CVD is more prominent in males as compared to females. It is worth mentioning that the effects of age and gender on lipid profile may be different in persons less than 60 years[13]. This hypothesis is supported by the results of the third examination cycle of the Framingham Offspring Study conducted in those with mean age 49±10 years. Framingham Offspring Study revealed higher plasma levels of LDL-cholesterol in men compared with women. In addition, increased age was associated with higher plasma LDL-cholesterol, especially in women. After adjustment for age and body mass index, LDL cholesterol levels were still significantly higher in postmenopausal than in premenopausal women, indicating a hormonal effect on LDL metabolism[13]. Two years later, the effects of gender and menopausal status on plasma lipids were studied and three groups of healthy subjects: 72 premenopausal women, 74 postmenopausal women and 139 males, were examined[14]. Data indicated that women have significantly higher values of HDL-cholesterol, and lower values of triglyceride than men. This also supports our finding that females have a lower serum triglyceride values than males and the age group mentioned also corresponds to the group of our subjects[13].

5. Conclusion

The objective of our research was to study the lipid profile, and uric acid levels in patients with Type 2 Diabetes Mellitus with respect to the diet habits. It was observed that the results coincided with previous research irrespective of the diet. However more detailed investigations need to be carried out to measure the exact proportion of diet with respect to nutritional values. BMI, and waist circumference of the patients as well as drug monitoring is also essential. A thorough family history of patients could help in detection of CVD and T2DM at early age. Screening of T2DM and lipid profile levels should be started at the age of 20 to detect early changes. Screening of uric acid levels is a cost-effective way of detection of early metabolic syndrome and insulin resistance in pre-diabetic cases. Glycosylated hemoglobin (HbA1C) determination should be recommended on regular basis rather than depending on traditional fasting and post-prandial blood glucose levels for the monitoring of T2DM. Also, monitoring of serum insulin levels, both fasting and post-prandial, should be ideally considered for monitoring the progress of the disease.

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