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Research Article

RELATIONSHIP OF C-REACTIVE PROTEIN, URIC ACID, LIPID PROFILE WITH TYPE 2 DIABETES MELLITUS IN TRINIDAD

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ABSTRACT

Objectives: To examine the relationship of C-reactive protein (CRP), lipid profile, uric acid, age and gender in subjects with type 2 diabetes and to determine whether there are links between these variables and disease manifestations.

Methods and materials: A retrospective study comprised 206 patients from two major hospitals of Trinidad and Tobago with (67) and without (139) diabetes.

Results: There were 117 females (57%) and the majority of participants were Indo-Trinidadians (60.7%). The diabetic subjects had elevated C-reactive protein (0.95 mg/L±1.6), uric acid (6.0 ± 2.1), triglycerides (155.53 ± 82.14) and LDL cholesterol (123.35± 51.84) when compared to non-diabetic population with CRP (0.48 mg/L± 0.56) uric acid (5.66 ± 2.47), triglycerides (138.39 ±72.22) and LDL-cholesterol (117.36 ± 35.50). The incidence of diabetes showed a normal distribution, increasing with age and peaking in the 50-59 age groups. An association was observed between uric acid and lipid profile in diabetic subjects. After adjustment for age and gender, in the diabetic population with an elevated CRP, a direct relationship was observed between uric acid and cholesterol levels as the same patients show marked elevations in both categories.

Conclusions: Our study did not found any useful predictors for CRP and diabetic subjects. The CRP levels within the participants fluctuated to a great extent and showed no correlation with increased uric acid, lipid profile or diabetic status.

Keywords: CRP; diabetes; age; gender; lipid profile.

INTRODUCTION

Diabetes mellitus is due to absolute or relative insulin deficiency. It has been defined by the World Health Organization (WHO), as a fasting plasma venous glucose concentration greater than 7.8mmol/litre (140mg/dl) or a concentration of 11.1 mmol/L (200mg/dl) or more, two hours after a carbohydrate meal or two hours after oral ingestion of the equivalent of 75g of glucose, even if the fasting concentration is normal (1). Diabetes mellitus is one of the most common chronic diseases worldwide. According to WHO, diabetes mellitus ranks numbers eight and ten as the leading causes of death in high income and middle-income countries respectively (2). This research project focuses on type 2 diabetes mellitus and C - reactive protein.

C-reactive protein (CRP) is produced by the liver and found in the blood but are considerably low in the blood of healthy persons. After an injury, infection, or inflammation they become elevated and last for the duration. Once healed, or the infection or inflammation goes away the CRP present in the blood diminishes. Inflammation, according to a study conducted by Greenfield and Campbell is suggested to be a cause of insulin resistance and type 2 diabetes mellitus as indicated by the elevated levels of CRP in the blood (3).

Lipid profile is a group of tests ordered to determine a person's risk of coronary heart disease. A person with diabetes' abnormal lipid profile is referred to as diabetic dyslipidemia. Patients with type 2 diabetes have an atherogenic lipid profile (4) with the characteristics of this condition being: HDL-C - low levels (≤ 35mg/dl), LDL-C - relatively normal and triglyceride - high levels (≥ 250mg/dl).

Uric acid is the end result of metabolism. It is poorly soluble in plasma and therefore precipitates into tissues where it crystallizes in joints especially those in the feet leading to a condition known as gout. Gout is an inflammatory response and would lead to the release of C- reactive proteins into the blood. An increase in serum uric acid is seen in cases of increased insulin resistance, which could lead to an increase in CRP in people with type 2 diabetes.

According to a study conducted by Nayak et al age was found to be a significant predictor of type 2 diabetes with a frequency of 35.6% in the 31-40 year age group compared with 73.7% in 80 years and over, suggesting and increase in risk/ prevalence of the disease with an increase in age (6). Nayak et al and the American National Diabetes fact sheet showed diabetes being more prevalent in males than females. Nayak et al findings stated that male gender increased the risk for type 2 diabetes by a significant 16% while the American National Diabetes fact sheet stated 11.8% of men and 10.8% of women within the age group 20 and over suffered with type 2 diabetes (6). According to Lakoski et al women have higher median CRP levels than men (7).

National Diabetes fact sheet stated that of the adults aged 20 and above, 67% have high blood pressure. In diabetes the usual mechanism of maintaining blood pressure at normal levels, nitric oxide which is usually present in the endothelial cells of blood vessels is disrupted, hence the strong relationship between high blood pressure and diabetes. A study conducted by Smith et al concluded that CRP levels are associated with blood pressure but an elevated level does not lead to elevated blood pressure levels (8).

Smith et al. (2005) and Ndumele et al (2006) conducted research on type 2 diabetes and its link with blood pressure, age, C-reactive proteins or all of the above. This research project has joined those many groups and focused on C-reactive proteins in diabetes linking it with lipid profile, uric acid and anthropometric variables.

Based on research done thus far, there is an association with C-reactive protein and type 2 diabetes. In fact Greenfield and Campbell (2006) in Sydney Australia, (3) have concluded that inflammation has been an important risk factor for development of both insulin resistance and type 2 diabetes mellitus due to the elevated levels of CRP and inflammatory markers. Ndumele et al (2006) showed that inflammation and CRP levels are linked to insulin resistance, impaired insulin sensitivity and development of type 2 diabetes (9). Both of them concluded that there is in a link between CRP and diabetes.

One of the factors researched in the project was the relationship between lipid profile and diabetes. With regards to the abnormal lipid profile, studies suggest that there is a link between abnormal lipid profile and diabetes. Windler E. (2005) compared and contrasted the lipid profile of non-diabetics and diabetics finding that patients with type 2 diabetes are more likely to have the atherogenic form of LDL-C than non- diabetic subjects (10). Nayak et al showed no significant difference between the mean HDL levels of diabetics and non-diabetics was seen (11).

The purpose of this study is to examine the relationship of uric acid, lipid profile and anthropometric variables: age, gender and blood pressure with CRP and determine whether there is in fact a link between these variables in Trinidadian type 2 diabetics. Majority of the studies cited are of studies outside of the Caribbean. This research project intends to add to the already known information about this topic.

Materials and methods

The retrospective study was used to determine the link between high C-reactive protein, abnormal lipid profile, uric acid levels, gender and age in type 2 diabetic patients. The target population focused on was diabetic and non-diabetic subjects in Trinidad and Tobago with non- diabetics being used for comparison with the diabetic subjects. The data was collected from 206 patient records from San Fernando General Hospital and Eric Williams Medical Sciences Complex in Trinidad.

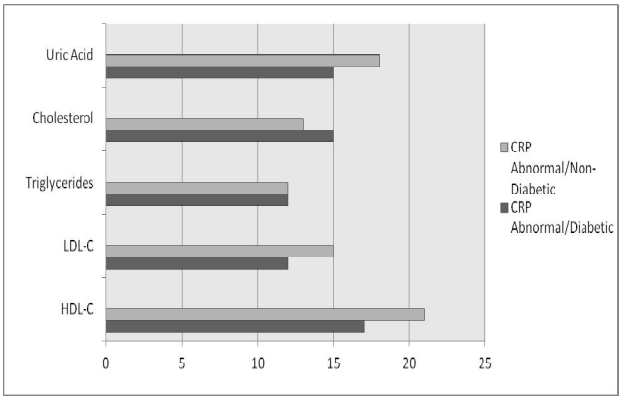
Inclusion criteria of persons in the study were type 2 diabetics and non-diabetics for comparison, males and females between the ages of 21 and 90 of all ethnicities.

Exclusion criteria were the patients not meeting the above criteria, pregnant women, records dated prior to 2006, patients with complications of type 2 diabetes and inflammatory disorders that would affect the CRP levels.

The primary variables collected were CRP, uric acid, lipid profile (TG, HDL-C, LDL-C, and total cholesterol), gender and age. Patients with random venous plasma glucose levels greater than 126mg/dl, who fit the inclusion criteria, were used as the diabetic patients in the study and those with normal glucose levels who also fit the inclusion criteria were used as non-diabetic patients.

Data collected was organized into diabetic and non-diabetic and analyzed by the Statistical Package for the Social Sciences (SPSS) system. SPSS was used to give Descriptive and Interpretative results of the findings.

Figure 1: Elevated variables of diabetic and abnormal CRP subjects compared to non-diabetic subjects with abnormal CRP.



RESULTS

The number of diabetics was less in the younger age group ranging from 21-30 years (Table 1). Type 2 diabetes is more prevalent in persons 35 years and older. In observing our study population the prevalence of diabetes increased in age from 20-59, which supports data that says there is a correlation with type 2 diabetes and increasing age. Our study noted the presence of more people in 50-59 age groups when compared to all other age groups. For age and gender, females dominated the total population with 117 total subjects over the males (89 subjects). To focus on the 50-59 age groups which have the greatest prevalence of diabetes, females also dominated with 62% of that population.

Table 1 Demographic status of the sample population

Age group	Total (non-diabetic/diabetic)
20-29	10 (9/1)
30-39	22 (20/2)
40-49	33 (21/12)
50-59	51 (25/26)
60-69	37 (24/13)
70-79	27 (18/9)
80-90	9 (5/4)
CRP Level	
Abnormal	68 (40/28)
Normal	139 (94/45)
Gender	
Male	89 (51/28)
Female	117 (72/39)
Ethnicity	
Indo-Trinidadian	111 (69/42)
Afro-Trinidadian	63 (44/19)
Mixed	16 (10/6)

Table 2 Calculated mean of all variables for the sample population

Variable	Mean	Standard Deviation	Standard Error
Age	54.680	15.382	1.072
CRP	0.651	1.065	0.074
Uric Acid	5.818	2.348	0.163
Cholesterol	189.233	49.179	3.426
Triglycerides	146.057	78.375	5.460
LDL-C	117.902	41.522	2.892
HDL-C	46.830	18.841	1.312

Our study utilized high sensitivity CRP which can detect CRP levels as low as 0.04mg/l. The CRP level of above 0.5 mg/l considered abnormal. In the sample population, 33% of subjects had an abnormal CRP level and when correlated with a diabetic status, 41% of the subjects showed a diabetic status coupled with an abnormal CRP level. Figure 2 graphically represents our target population of diabetic and non-diabetic with an abnormal CRP. Uric acid was elevated in 54% of diabetic subjects compared to 60% of the population who showed a non-diabetic status and normal CRP levels having a normal uric acid. Cholesterol levels

were also elevated in 54% of subjects as stated previously, in the same population with an increased uric acid. This is compared to 51% of the non-diabetic (normal CRP) population showing an either normal or low cholesterol level. The triglyceride and LDL-C levels in the target population were increased, whereas in the non-diabetic (normal CRP) population they were normal in 75% and 65% respectively. Finally, the HDL-C in our target population was decreased in 75% of subjects showing that this was the single most important variable (Table 2).

DISCUSSION

In this study, the relationship between C-reactive protein (CRP) and lipid-profile, along with glucose levels in diabetics, were investigated. Of the 207 subjects 60.7% were East Indian, 57% were female, and 77.6% were 50 years or older. It can therefore be seen that a person's age is a definitive marker for the prevalence of diabetes, as was expected. To focus on the 50-59 age groups which have the greatest prevalence of diabetes, females also dominated with 62% of that population. This correlates with a study done by the Red Cross which indicated that females in the age group are among the greatest prevalence with the disease (12).

On analyzing the data, it can be seen that no direct relationship between elevated CRP levels and diabetes existed. CRP was found to be elevated in some diabetic subjects; however there was no apparent trend and the distribution was erratic. The occurrence of elevated CRP in diabetic patients can therefore be considered coincidental. Observing the uric acid levels and cholesterol levels in those diabetic subjects with an elevated CRP these categories show a total of 15 subjects each. This supports a study that found a correlation between elevated uric acid levels in subjects who had metabolic syndrome, which includes diabetes, elevated cholesterol and increased LDL levels (13). CRP is an inflammatory marker and thus, may have been elevated due to co-existing conditions. In past studies performed, there were demonstrated associations between elevated levels of circulating acute phase inflammatory markers, typified by CRP and the development of type 2 diabetes (1). CRP has been seen to be elevated in patients suffering from hypertension and cardiac diseases, especially myocardial infarctions, and recent studies have shown a possible link between elevated CRP levels and decreased insulin sensitivity, but research is still inconclusive (2).

There were no useful predictors that found a correlation between C-reactive protein, diabetes mellitus, uric Acid level and an elevated lipid profile. It was conclusive that there is evidence of age being a compounding factor for Diabetes. However, CRP continues to show evidence as an inflammatory marker signaling infection once elevated and literature suggest that the manifestation of diabetes continues to be a disorder that does not illicit and inflammatory response.

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