

ORIGINAL ARTICLE

ASSOCIATION BETWEEN ALTERED LIPID PROFILE, BODY MASS INDEX, LOW PLASMA ADIPONECTIN AND VARIED BLOOD PRESSURE IN TRINIDADIAN TYPE 2 DIABETIC AND NON-DIABETIC SUBJECTS

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ABSTRACT

BACKGROUND: The obesity and hypertension have become the causes for the development type 2 diabetes. There is a limited study done on the contribution of body mass index (BMI) to blood pressure (BP) in the Caribbean population. Aim of our study was to determine the associations between lipid profile, BMI, adiponectin, and BP in Trinidadian type 2 diabetic patients with regards to age and ethnicity. **MATERIALS AND METHODS:** This was a cohort study comprised of 266 subjects (85 males and 181 females) attending primary and tertiary healthcare settings in central Trinidad. Of which, 126 diabetic subjects were matched with 140 non-diabetic subjects. Along with clinical history and anthropometry, adiponectin and lipid profile were measured in fasting blood samples. **RESULTS:** The diabetic group had higher triglycerides, very low density lipoprotein (VLDL), and BP values which were statistically significant ($P < 0.05$) when compared to non-diabetic subjects. The high-density lipoprotein cholesterol (HDL-c) and adiponectin were lower in diabetic subjects. HDL-c showed significant changes for ethnicity ($P = 0.013$) and gender ($P = 0.043$). The mean adiponectin concentrations were found to be significantly different among the ethnic groups ($P = 0.001$). Systolic pressure varied significantly with age ($P = 0.018$). As age increased, BP also increased. Ethnic groups had a significant difference in diastolic pressure ($P = 0.027$). East Indians had the highest mean diastolic pressure (80.74 ± 10.29) when compared to all other ethnic groups. **CONCLUSION:** HDL-cholesterol, low levels of adiponectin, and varied BP are associated in Trinidadian type 2 diabetic subjects with regards to age, gender, and ethnicity.

Key words: Adiponectin, blood pressure, body mass index, lipid profile, type 2 diabetes

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INTRODUCTION

There is a growing burden of obesity and hypertension in developing countries; however, there is limited studies done on the contribution of body mass index (BMI) to blood pressure (BP) in such populations. It is estimated that high BP is the cause of 7.1 million deaths, and there are more than 300 million obese people worldwide as stated by the World Health Organization (WHO). Obesity increases the risk of high BP, coronary heart disease, ischemic stroke, type 2 diabetes mellitus, and certain cancers.^[1] In particular, it has been established that BMI is a significant predictor of cardiovascular disease and type 2 diabetes mellitus.^[2] Furthermore, it was found that BMI is positively and independently associated with morbidity and mortality from hypertension.^[3] The correlation between BMI and lipid profile has long been studied internationally^[4-7] and it is explained that BMI increases due to an increase in adiposity characterized by decreased high-density lipoprotein cholesterol (HDL-c) and increased triglycerides.^[8]

These positive associations between body mass, BP, and lipid profile have been well documented in Caucasian populations. This relationship, however, is not adequately explored in Caribbean populations. Although there is a significant difference in plasma lipids in various population groups due to differences in geographical, cultural, economical, social conditions, dietary habits and genetic makeup, it is indeed useful to investigate the association of lipid profile and BMI to BP within a regional context.

In addition, adiponectin, the protein that is almost exclusively secreted from adipocytes, is a potent modulator of glucose and lipid metabolism and an indicator of metabolic disorders.^[9] The metabolic effects of adiponectin, including insulin sensitivity, seem to become stronger with increasing adiposity, i.e., with increasing obesity. It is also seen that adiposity may also affect the relationship of adiponectin concentrations with serum lipid profile; markers of inflammation, atherosclerosis, and endothelial function; and ectopic fat accumulation.^[10] There is much evidence which suggests that low adiponectin concentrations are associated with low concentrations of HDL-c and high concentrations of triglycerides^[10] and are predictive of type 2 diabetes mellitus onset.^[11] However, the relationship of adiponectin to other types of cholesterol is inconsistent.

Low plasma adiponectin levels can be affected by BMI as seen in a study on a human adiponectin encoding gene haplotype leading to low plasma adiponectin concentrations associated with type 2 diabetes in obese and morbidly obese but not in lean persons.^[12] Therefore, the effect of BMI and co-morbidity factors such as type 2 diabetes mellitus on the relationship of adiponectin with plasma lipids and lipoprotein concentrations is also targeted in this study.

Many researchers demonstrated the association of lipid profile and BMI with type 2 diabetes and there are very limited literature available on the relationship of adiponectin with lipid profile, BMI, and BP in Trinidadian type 2 diabetic population. Therefore, this study was conducted to determine the association between the abnormal lipid profile and BMI to

low plasma adiponectin levels. In addition to this, type 2 diabetes mellitus status is assessed in order to establish whether it is a contributing factor to any of the above associations.

MATERIALS AND METHODS

Research design and method

A cohort study involving convenience sampling was used to identify the association between the abnormal lipid profile and BMI to low plasma adiponectin levels. In addition to this, type 2 diabetes mellitus status is assessed in order to establish whether it is a contributing factor to any of the above associations.

Sample specification

Data were obtained from the clinical records of diabetic and non-diabetic hospital outpatients and clinic patients accessing two hospital-based outpatient diabetic clinics and two primary care facilities in Trinidad, West Indies. Males and females of all ethnicities were eligible to participate except heavy smokers (person who smoke more than 20 cigarettes per day) and/or heavy drinkers (who consume an average of more than two drinks per day and who consume more than one drink per day). The exclusion criteria were necessary since heavy smoking and/or drinking are known to modify the adiponectin levels and inflammation. Associated exclusion factors included presenting with complications of type 2 diabetes mellitus including nephropathy and retinopathy; persons having chemical or physical trauma, immunological disorder, being treated with immunosuppressants, and corticosteroids, known to have human immunodeficiency virus or any other coexisting infection(s). Medical records from the two hospitals and the two

clinics were used to construct the sampling frame from which potential participants were selected.

Eligible participants were then invited to participate and informed consent was obtained once each person agreed verbally to participate. Ethical approval of the design, methods and implementation of the study was granted by the Ethics Committee of the Faculty of Medical Sciences, The University of the West Indies St. Augustine.

Description of outcome measurements

The variables that were measured and recorded included ethnicity, age, sex, past medical history, history of smoking and alcohol use, and other known medical conditions (e.g., hypertension). These were obtained during face-to-face patient interviews. To obtain clinical data, participants were invited to visit the various clinics following an overnight fast. At the clinic, measurements of BP, height, weight, BMI, hip circumference, waist circumference, and waist to hip ratio were taken using established protocols with the necessary precautions. A fasting venous blood sample was obtained, processed, and stored at -20°C for biochemical analysis. Blood levels of adiponectin were measured using enzyme-linked immunosorbent assay (GenWay Biotech, Inc. San Diego); glucose and lipid profile were measured using a dry chemistry analyzer (Johnson and Johnson Vitros 250, Ortho-Clinical Diagnostics Inc., NY, USA) with appropriate quality controls.

RESULTS

The sample size of 266 patients comprised of 32.0% (85) males and 68.0% (181)

females. The mean age of the sample was 50.90 ± 12.78 years with the modal age group being 50-60 groups. East Indians accounted for 77.4% (206) and Africans made up 15.0% (40) of the sample. Patients of mixed and Chinese origin accounted for 7.5%.

The diabetic group comprised of 47.4% (126) and non-diabetic group comprised of 52.6% (140) of the sample. Table 1 shows a comparison between both groups. The diabetic group had higher glucose, cholesterol, triglycerides, VLDL, and BP values with the significant differences when compared to non-diabetic subjects [Table 1]. However, HDL and adiponectin were lower in diabetics. Generally, diabetics were older with the mean age being 55.54 ± 8.37 years.

Table 1: Comparison of features between diabetics and non-diabetics

Features	Mean±standard deviation		P value
	Diabetic (n=126)	Non-diabetic (n=140)	
Age (years)	55.54±8.37	46.73±14.525	0.000
Glucose (mg/dl)	154.83±76.53	89.63±26.11	0.000
Cholesterol (mg/dl)	210.62±106.87	202.09±41.79	0.105
Triglycerides (mg/dl)	160.91±101.34	133.25±82.57	0.015
HDL (mg/dl)	44.46±12.23	49.47±15.02	0.043
LDL (mg/dl)	126.56±39.50	126.38±36.17	0.485
VLDL (mg/dl)	31.29±22.28	24.49±14.58	0.042
Adiponectin (ng/mL)	20.50±9.63	24.77±16.98	0.002
Systolic pressure	135.54±20.03	128.18±18.96	0.386
Diastolic pressure	80.63±9.83	79.22±11.19	0.054
BMI	27.32±5.90	26.43±6.12	0.663

*For testing differences between means, Values <0.05 indicate significance, BMI=Body mass index, HDL=High density lipoprotein, LDL=Low density lipoprotein, VLDL=Very low density lipoprotein

Table 2: Comparison of lipid profile among ethnicities

Ethnicity	Mean±SD (mg/dl)				
	Cholesterol	Triglyceride	HDL-c	LDL-c	VLDL-c
East Indian (n=206)	209.16±13.16	155.98±99.00	45.67±13.16	128.06±38.96	28.06±20.25
African (n=40)	198.46±40.44	103.03±49.98	51.78±16.04	125.53±32.77	21.60±10.34
Mixed (n=12)	189.94±32.14	136.53±69.22	51.18±15.92	109.65±28.56	36.67±7.23
Chinese (n=8)	208.67±47.50	117.33±32.32	59.67±6.43	125.67±51.73	19.00±0.00

HDL=High density lipoprotein cholesterol, LDL=Low density lipoprotein, VLDL=Very low density lipoprotein

Univariate general linear models were used to analyze the relationship among abnormal lipid profile and BMI with low plasma adiponectin and varied BP using age, gender, ethnicity, and diabetic status. HDL-c showed significant changes for ethnicity ($P = 0.013$) and gender ($P = 0.043$). The mean HDL-c value for males is 41.38 ± 11.24 mg/dl and 47.10 ± 13.97 mg/dl for females. Considering ethnic groups, there was a significant mean difference between East Indians and Africans ($P = 0.039$). Table 2 compares the lipid profile by ethnicity. There was no other significant relationship found between lipid profile and age, gender, ethnicity, and diabetic status.

The mean adiponectin concentrations were found to be significantly different among the ethnic groups ($P = 0.001$). Chinese had a significantly higher mean difference when compared to any other ethnicity. Furthermore, there were several interactions between age, gender, ethnicity, and diabetic status with adiponectin concentrations [Figures 1a-c]. BMI had no significant relationship with age, gender, ethnicity, and diabetic status. This might have been due to 29.7% (79) obese subjects.

Systolic pressure varied significantly with age ($P = 0.018$). As age increased, BP also increased. The age group 21-30 had a significantly lower systolic BP (112.91 ± 12.64 mmHg) than all other age

groups except 31-40. All age groups had a significantly lower systolic BP than the age group older than 60 years (140.15 ± 19.63 mmHg) excluding the 51-60 age group.

Ethnic groups had a significant difference in diastolic pressure ($P = 0.027$). East Indians had the highest mean diastolic pressure (80.74 ± 10.29 mmHg) when compared to all other ethnic groups. There was an interaction between diabetic status

and ethnicity as illustrated by the profile plot in Figure 2.

The results of our study showed the association between HDL-c, low levels of adiponectin, and varied BP in Trinidadian Type 2 diabetic subjects with regards to age, gender, and ethnicity.

DISCUSSION

This study was used to identify the association between the abnormal lipid profile and BMI to

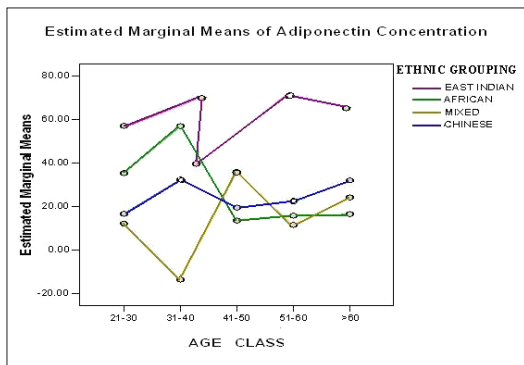


Figure 1a: Profile plots showing the interaction for adiponectin concentration with respect to age and ethnicity

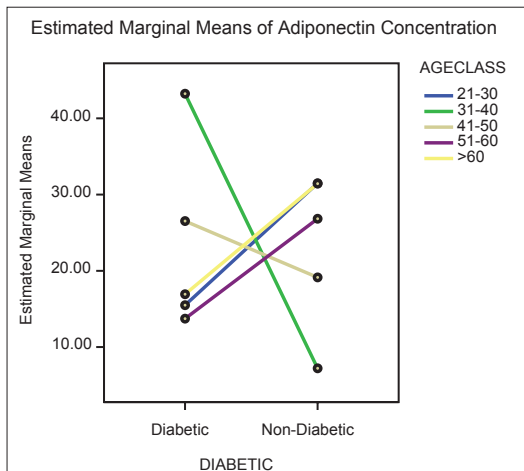


Figure 1c: Profile plots showing the interaction for adiponectin concentration with respect to age and diabetes

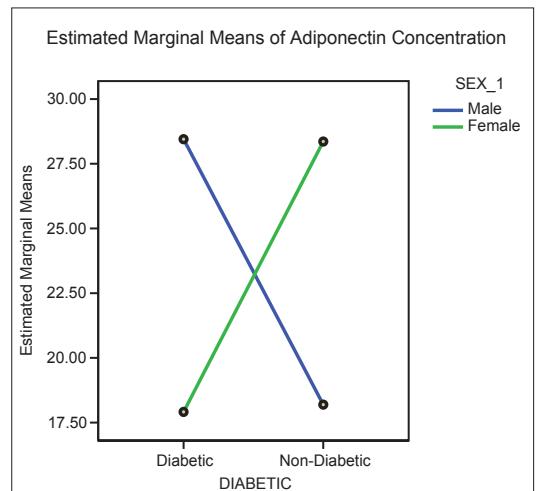


Figure 1b: Profile plots showing the interaction for adiponectin concentration with respect to sex and diabetes

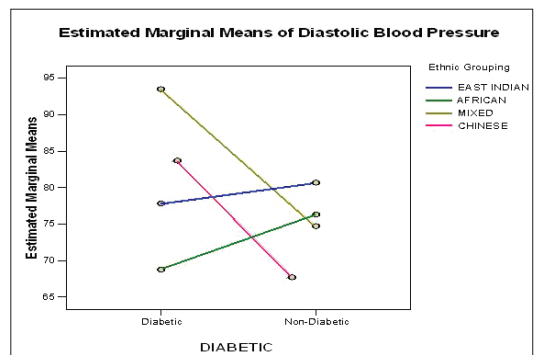


Figure 2: Profile plot showing the interaction for diastolic blood pressure with respect to ethnicity and diabetes

low plasma adiponectin levels. Studies have been done on the associations between BMI and BP.^[13]

The findings of this study indicated that there were higher glucose, cholesterol, triglycerides, VLDL, and BP values among the diabetic group. However, HDL and adiponectin were lower for the same group. Similar observations were demonstrated by other researchers.^[12] The mean HDL-c value found for females was higher which was consistent with the work done by Gardner *et al.*,^[14] when ethnicity was compared, Chinese had the highest mean HDL-c value (59.67 ± 6.43), whereas East-Indians had the lowest (45.67 ± 13.16), which is attributable to differences in lifestyle and genetics.^[15]

The mean adiponectin concentrations were found to be significantly different among the ethnic groups. Markedly, Chinese had a significantly higher mean difference as compared to any other ethnic groups used in this study. In a study by Mente *et al.*, it was found that South Asians (East-Indians) displayed the least favorable adipokine profile (lower adiponectin and higher leptin) of all ethnic groups, despite having BMI comparable to that of Europeans. This is comparable to the findings in this study as East-Indians also had the lowest mean difference in adiponectin values. Further interactions were found between adiponectin to age, gender, and diabetic status. Plasma adiponectin levels were significantly higher in females than in males in the non-diabetic group^[16] and these findings were reversed for the diabetic group. The 51-60 and >60 age groups showed an increase in plasma

adiponectin values in the non-diabetic group, whereas 31-40 and 41-50 age groups showed a lower plasma adiponectin value for the non-diabetic group. In a study by Ho Lee *et al.* which stated that there was a strong negative correlation ($R = -0.37$, $P < 0.001$) in younger women (<40 years), whereas a weak significant relationship ($R = -0.18$, $P < 0.05$) was found in older women (≥ 40 years). As compared to this study where males were also included, non-diabetic persons aged more than 50 years had a positive interaction, whereas those between 31-50 age groups had a negative association.

When BP was evaluated, systolic pressure varied significantly with age. Generally, as age increased, BP also increased, showing a positive association between age and BP. In a study by Tesfaye *et al.*, it was found that systolic pressure and diastolic pressure were positively correlated with age while BMI was not. These findings are also supported by other studies.^[17]

Furthermore, when ethnic groups were compared in terms of BP values, it was found that East-Indians had a significant difference in diastolic pressure in relation to other ethnic groups. They also had the highest mean diastolic pressure value (80.74 ± 10.29 mmHg).

Interactions between ethnicity and diabetic status with BP were also seen showing East-Indians and Africans having a higher mean diastolic pressure in the non-diabetic group. This can be attributable to use of pharmacological agents by the diabetic group, as hypertensive status was not included in this study and therefore persons taking glycemic

drugs could also be on hypertensive drugs. There is a very high positive association of diabetes mellitus with hypertension; however, the reasons for such are still yet to be confirmed.^[18] Also East-Indians and Africans have the mean highest diastolic pressure values when compared to other ethnic groups and this observation was similar to the work done by.^[19]

CONCLUSIONS

HDL-c, low levels of adiponectin, and varied BP are associated with Trinidadian type 2 diabetic subjects with regards to age, gender, and ethnicity. No significant association was found for BMI. East-Indians are more at risk for developing diabetes mellitus and the lipid abnormality. The lipid profile, BP, and adiponectin values should be monitored consistently and accurately in diabetic patients to avoid further complications.

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