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Correlation of serum adiponectin with glycemic control and lipid profile in newly diagnosed type 2 diabetes mellitus patients

N. Soumya[1], B.R Balaji[2] & D. Selvakumar[3,*]

[1]Department of Biochemistry, Sri Devaraj Urs Medical College, Sri Devaraj Urs Academy of Higher Education and Research, Tamaka, Kolar, India; [2]Department of Biochemistry, APS Medical College Hospital and Research Institute Mevalurkuppam Village, Valarpuram Post, Sriperumbudur Taluk, Kanchipuram District, Tamil Nadu, India; [3]Department of Biochemistry, Dhanalakshmi Srinivasan Institute of Medical Sciences and Hospital, Thuraiyur Road, Perambalur, Tamil Nadu, India; *Corresponding author

Affiliation URL:
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Author contact:
N. Soumya - E-mail: drsoumyaravind@gmail.com
B.R Balaji - E-mail: balajibr92@gmail.com
D. Selvakumar - E-mail: selvadbio@gmail.com

Abstract:
Type 2 diabetes mellitus is a one of the leading disease had highest mortality and morbidity in worldwide, which is due to relative are absolute insulin deficiency and resistance adiponectin is a adipocytokine with primary role of regulating carbohydrate and lipid metabolism through insulin secretion and sensitivity in tissues. Therefore, it is of interest to correlate the serum adiponectin with glycemic control and lipid profile in newly diagnosed type 2 diabetes mellitus patients. This study recruited a total one hundred and twenty subjects, among this sixty type 2 diabetes mellitus and remaining were healthy controls. The fasting venous blood sample were collected for measurement of blood sugars, glycated hemoglobin and lipid profile and adiponectin levels. Serum adiponectin levels were significantly decreased in type 2 diabetes mellitus patients when compared to controls and these levels were inversely correlated with blood sugars, glycated hemoglobin, total cholesterol, triglycerides, very low-density lipoprotein and low-density lipoprotein (P=0.001**). Thus, data show that serum adiponectin might be considered a clinically relevant potential and therapeutic marker for management of blood sugars and lipid profile in newly diagnosed type 2 diabetes mellitus patients.

Keywords: Adiponectin, glycated hemoglobin, glycemic control, lipid profile and type 2 diabetes mellitus (T2DM)

Background:
Type 2 diabetes mellitus (T2DM) is due to increase blood sugar's caused by insulin resistance and beta cells failure **[1]**. The prevalence of T2DM increasing a yearly basis, around 578 million adults were diagnosed with T2DM in 2026 and increasing up to 700 million by 2025 **[2]**. In Indian scheme 101 million people were suffering with T2DM in 2026 and this number enhance up to 156.7 million by 2050 **[3]**. Due to metabolic abnormalities in T2DM patients may have major consequences such as neuropathy retinopathy, atherosclerotic diseases and nephropathy results reduce the quality of life and increase morbidity and mortality. Metabolic imbalances, hyperglycemic and insulin resistance triggers oxidative stress and inflammation in T2DM lipids or fats stories in the adipose tissue and recent studies reports adipose tissue consider as major metabolic regulators in the body through secretion of numerus proteins and hormones **[4]**. There are two different types of adipocytokines produced from adipose tissue, which will enhance oxidative stress, inflammation and insulin resistance known as proinflammatory cytokines and which adipokines decrease oxidative stress, inflammation and insulin resistance is known as anti-inflammatory adipokines. Improper secretion and imbalance between proinflammatory and anti-inflammatory adipokines leads to insulin resistance, hyperglycemia proatherogenic and endothelial dysfunction in T2DM patients **[5]**. Adiponectin is a collagen contains adipocytokine with 244 amino acid and has significantly direct relationship with T2DM though its insulin sensitivity effects **[6, 7]**. It has anti-inflammatory and insulin sensitivity hormonal effects increase uptake of blood sugars in tissues and simultaneously regulates gluconeogenesis results improving glycemic control **[8, 9]**. According to the recent studies decreased levels of serum adiponectin which decline in tandem with the development of decreased insulin sensitivity in T2DM **[10]**. Decreased serum adiponectin, hyperglycemia, dyslipidemia and inflammatory mechanism's leads to cardiovascular morbidity and mortality in T2DM **[11, 12]**. Therefore, it is of interest to evaluate the relationship between blood sugars and lipid profile in newly diagnosed T2DM patients.

Materials and Methods:
This is a cross sectional study conducted between October 2023 and September 2024 at department of biochemistry collaborated with general medicine, PES University Institute of Medical Science and Research, Bangalore, India. A total 120 subjects, among this sixty (60) newly diagnosed T2DM patients according to american diabetes association (ADA) criteria **[13]** and also another 60 subjects were age and gender matched healthy controls were recruited. The study conducted after taken approval from institutional ethics committee and participants recruited after obtained written consent form all the study participants.

Sample collection:
5ml of fasting over-night venous blood sample drawn from all the study participants and transferred 1ml into fluoride tube, another 1ml transferred to ethylene diamine tetra acetic acid (EDTA) tube and remaining 3ml transferred into serum separation tube. The plasma and serum separated by centrifugation at 3000 RPM for 10 minutes and plasma, serum transferred into properly labeled aliquots. The aliquots stored at -70^0C until analysis was done.

Methods:
Fasting blood sugars (FBS), total cholesterol (TC), triglycerides (TGL), high density lipoprotein (HDL) analyzed by international federation of clinical chemistry methods, glycated hemoglobin (HbA1c) determined by latex immunoturbidimetry method, serum adiponectin was estimated by enzyme linked immunosorbent assay. The very low-density lipoprotein (VLDL) and low-density lipoprotein (LDL) was calculated by fried wald's formula and body mass index (BMI) were calculated by weight in kilograms divided by height in meter square.

Statistical analysis:
The data entered into Microsoft Excel spread sheets and data represented mean ± standard deviation. The comparison between the variables done by using analysis of variance and correlation between the variables done by using Pearson's correlation. The probability value is considered less than 0.05 statistically significant.

Results:
Table 1 shows the basic contextual, biochemical and clinical parameters of the study participants. The newly diagnosed T2DM patients and controls did not shown significantly differ in age (P=0.375) and BMI substantially higher in newly diagnosed T2DM patients than controls (P=0.001**). The newly diagnosed T2DM patients had significantly greater systolic and diastolic blood pressure than controls (P=0.001**). The fasting blood sugars, TC, TGL, VLDL, LDL and HbA1c considerably higher in newly diagnosed T2DM patients when compared to controls (P=0.001**). Along with that newly diagnosed T2DM patients had significantly decreased HDL levels when compared to controls (P=0.001**). Adiponectin levels significantly decreased in newly diagnosed T2DM patients when compared to controls (P=0.001**). **Table 2** illustrates the serum adiponectin levels between male and female T2DM patients, the male T2DM patients had significantly very high levels of serum adiponectin when compared to female T2DM patients (P=0.001**). **Table 3** shows the correlation coefficient values between serum adiponectin and other parameters of the study. The serum adiponectin was statistically shown significant negative correlation with BMI, FBS, HbA1c, TC, TGL, VLDL and LDL (P=0.001**). Additionally, there was a significant positive correlation between serum adiponectin and HDL (P=0.001**).

Table 1: Basic contextual, biochemical and clinical parameters of the study participants

Parameters	Controls	Newly Diagnosed T2DM Patients	P-value
	Mean ± SD	Mean ± SD	
Age (Years)	47.12 ± 2.21	47.61 ± 2.32	0.375
SBP (mmHg)	116.5 ± 3.89	133.3 ± 7.27	0.001**
DBP (mmHg)	76.3 ± 1.36	85.77 ± 4.61	0.001**
BMI (kg/m2)	20.63 ± 2.81	34.18 ± 1.74	0.001**
FBS (mg/dl)	86.06 ± 11.18	150.1 ± 52.70	0.001**
Total cholesterol (mg/dl)	138.11 ± 29.05	262.6 ± 34.95	0.001**
Triglycerides (mg/dl)	115.62 ± 28.20	176.50 ± 12.70	0.001**
HDL (mg/dl)	44.27 ± 12.81	28.42 ± 12.70	0.001**
VLDL(mg/dl)	20.87 ± 5.49	53.12 ± 9.46	0.001**
LDL (mg/dl)	58.77 ± 15.36	144.50 ± 22.66	0.001**
HbA1C (%)	3.09 ± 0.475	8.55 ± 0.630	0.001**
Adiponectin (ng/dl)	20.95 ± 11.85	14.63 ± 8.87	0.001**

Table 2: The serum adiponectin levels between male and female T2DM patients

Parameters	Male T2DM Patients	Female T2DM Patients	P- value
	Mean ± SD	Mean ± SD	
Adiponectin (ng/dl)	15.19 ± 8.16	12.86 ± 5.66	0.001**

Table 3: Correlation coefficient values between serum adiponectin and other parameters of the study

Parameters	Serum Adiponectin	
	r- value	P- value
BMI (kg/m2)	-0.93	0.001
FBS (mg/dl)	-0.98	0.001
HbA1C (%)	-0.47	0.001
Total cholesterol (mg/dl)	-0.36	0.001
Triglycerides (mg/dl)	-0.06	0.001
HDL (mg/dl)	0.26	0.001
VLDL (mg/dl)	-0.65	0.001
LDL (mg/dl)	-0.35	0.001

Discussion:
In this study, we examined the relationship between serum adiponectin levels and blood sugars, lipid profile in newly diagnosed patients with type 2 diabetes mellitus and controls. The serum adiponectin levels were significantly decreased in newly diagnosed T2DM patients than controls. These observations are consistence with earlier studies suggested that serum adiponectin had significant effects in blood sugar metabolisms, the studies commonly reported there was a significantly decreased level of serum adiponectin in T2DM patients **[14-16]**. The decreased levels of serum adiponectin one of the major risk factor for insulin resistance and significantly correlated with diseases of carbohydrate and lipid metabolism **[17]**. The adiponectin considers antidiabetic factor which stimulates beta cell function and enhances insulin sensitivity through stimulation of insulin signaling receptors. Additionally, serum adiponectin significantly inhibits gluconeogenesis and enhances uptake of glucose, oxidation of fatty acids in the tissues **[18, 19].** In the present study found there was a significant negative correlation between serum adiponectin and blood sugars, HbA1c (P=0.001**). Similarly, previous studies also observed decreased serum adiponectin shown direct negative association with glucose and HbA1c. The results suggest serum adiponectin can serve as a earliest marker for glycemic control and abnormality in carbohydrate metabolism in T2DM patients **[20-23].** Additionally, we also observed the serum adiponectin was shown significant inverse correlation with BMI, TC, TGL, VLDL and LDL (P=0.001**). There was a significant positive correlation between serum adiponectin and HDL (P=0.001**). These study findings agree with earlier studies reports **[24, 25]**. According to the previous study reports there was a strong direct relationship with cardiovascular events due to decreased serum adiponectin, HDL levels and increased insulin resistance, hyperglycemia abnormal lipid profile, oxidative stress and inflammation in T2DM patients **[26-30].** Reduced levels of serum adiponectin are significantly correlated with poor glycemic control and dyslipidemia in T2DM patients. The serum adiponectin levels and its correlation with T2DM and cardiovascular disease events were differed across different ethnicity due to environmental and genetic factors.

Conclusion:
We show the newly diagnosed type 2 diabetes mellitus patients had significantly reduced levels of serum adiponectin when compared to healthy controls. Thus, serum adiponectin might be considered clinically relevant potential and therapeutic marker

for management of blood sugars and lipid profile in newly diagnosed type 2 diabetes mellitus patients.

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