Correlation of Serum Adiponectin and Anthropometric Parameters in Patients with Type -2 Diabetes Mellitus

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Abstract

Background: Adiponectin is a bioactive adipocytokine that is only released by mature lipocytes in fatty tissue.It can control inflammation, atherosclerosis, and insulin sensitivity.So the present study aimed to correlate serum adiponectin and anthropometric parameters in patients with type 2 diabetes mellitus and comparedthem to healthy subjects.

Materials and Methods: The present cross-sectional study included 300 subjects (150 with T2DM and 150 with healthy control). All of the subjects ranged in age from 25 to 65 years old. With informed consent, serum adiponectin and anthropometric parameters were measured. For statistical analysis, IBM SPSS version 26.0 was applied.

Results: Serum level of adiponectin was low in T2DM patients compared to healthy controls, and the difference was statistically significant (p=0.003). However, there was no significant difference in waist circumference. Serum adiponectin has a significant negative correlation with BMI and FBS (p=0.029, p=0.016), respectively. Serum adiponectin has shown a positive correlation with waist-hip ratio and a negative correlation with waist circumference(p=0.933, p=0.300),but the correlation was insignificant.

Conclusion: The study concludes that high levels of adiponectin play a protective role in lowering the incidence of T2DM and that low levels of adiponectin are associated with T2DM risk.

Keywords: Blood sugar, adiponectin, anthropometric parameters, T2DM

Introduction

Type 2 diabetes mellitus (T2DM) is common and has become one of the leading causes of death and morbidity worldwide. T2DM is characterized by impaired insulin secretion or insulin resistance, which is frequently associated with obesity and results in insulin resistance via adipocyte-derived protein secretion. Adiponectin is a bioactive adipocytokine that is only released by mature lipocytes in fatty tissue.(1)The polypeptide adiponectin has 247 amino acids and is secreted in a trio of oligomeric isoforms: a low-molecular-weight trimer, an intermediate-molecular-weight hexamer, and a high-molecular-weight complex.(2)Studies suggest that the high-molecular-weight isoform is the most biochemically active form and that T2DM and coronary artery disease are associated with lower levels of this isoform.(3–

5)It can control inflammation, atherosclerosis, and insulin sensitivity. It is the most widely produced adipocytokine by adipocytes and the only protein unique to adipose tissue that is negatively regulated in obesity.(6–8) Insulin stimulates GLUT4 channels in adipose tissue and muscle to increase blood glucose absorption while inhibiting gluconeogenesis in the liver. Insulin facilitates the formation of fat in adipose tissue and transforms glucose into glycogen, which is used as a form of storage in the liver.(9) Similar to insulin, adiponectin reduces blood sugar by enhancing GLUT4-mediated absorption of glucose in muscle and adipose tissues and preventing gluconeogenesis in the liver (10), and promoting fat synthesis in adipose tissues.(11)

Adiponectin has increased insulin sensitivity in genetically altered mouse models. (12)Some epidemiological studies have discovered that serum adiponectin is markedly decreased in states of insulin resistance, suggesting it is a marker of insulin resistance. (13,14)Although it is produced in adipose tissue, adiponectin levels in the blood are reciprocally correlated with body fat percentage in adults, and they significantly increase after weight loss.(15)Reduced levels of adiponectin are linked to higher risks for obesity, type 2 diabetes, hypertension, dyslipidemia, and waist-hip ratio (WHR). (16)

Material and Methods.

Subject selection

In the present cross-sectional study, we included 300 participants, 150 with type-2 diabetes mellitus and 150 healthy controls, who were matched for age and sex and ranged in age from 25 to 65years. All the subject diagnosed with T2DM was obtained from the outpatient and inpatients Department of Medicine, Rohilkhand Medical College, Bareilly, Uttar Pradesh, India. The healthy control subjects were recruited from individuals same region. The study was approved by Institutional Ethics Committee, RMCH in Bareilly, with approval number IEC/RMCH/84/2022/AUG.

All procedures in this study followed the 1964 Helsinki Declaration, any later amendments, and usually known ethical standards, and each subject completed an informed consent form.(17)

Inclusion and exclusion criteria

For the case, the subject diagnosed with T2DM as per the American Diabetic Association guidelines(18) aged between 25-65 years, with 8-12 hours of overnight fast, plasma glucose ≥126 mg/dl, and HbA1c ≥6.5 mg/dl were included in the study. The diabetic subjects with insulin-dependent diabetes mellitus, persons suffering from acute and chronic infections, alcohol consumers, pregnant and smokers were excluded from the study. For the control, Subjects with nondiabetic history were included in the study. While those persons suffering from acute and chronic infections, alcohol consumers, pregnant, and smokers were excludedfrom the study.

Data collection

All the subjects included in the study were delivered a questionnaire to record comprehensive medical history and physical examination.

Anthropometric measurements:-

Height was measured to the wall-mounted stature meter height tape, with the subject upright; barefooted; feet together; back and heels against the upright bar of height scale; head upright in Frankfort horizontal plane, looking straight ahead.(19)Weight was noted to the nearest kilogram (kg) with the subject standing on the digital electronic weighing machine with a minimum ofclothing. (20)Waist circumference in centimeters was measured by circumference measuring tape at the level of the umbilicus in a standing position. Hip circumference in centimeters was measured by circumference measuring tape at the level of greater trochanters in an upright position.

Body Mass Index (BMI) was calculated from the formula; [BMI= Weight in Kilogram/ (Height in meters)^2]. Waist to hip ratio was calculated from the formula; waist circumference in centimeters/ hip circumference in centimeters.

Blood sample collection and analysis

Using standard methods, a trained and certified phlebotomist collected six milliliters of fasting venous blood in an EDTA and fluoride tube.A commercially available ELISA kit measured the serum level of circulating adiponectin (Elabscience, USA).

Statistical analysis:

A statistical package of the social sciences (SPSS version 23.0) was used for data analysis. Data were represented as mean ± SD (standard Deviation). The independent sample t-test was used to compare the means of different parameters. Pearsoncorrelation coefficients were done to assess any correlation betweenadiponectin,FBS and anthropometric parameters. All the data were considered significant if $P< 0.05$.

Result:

In this study, 150 patients with T2DM between the ages of 25 and 65 years and 150 healthy controls between the same age and gender were included. The mean age of T2DM patients and controls were (48.89±8.81 years) and (48.43±8.86 years) respectively. In terms of sex, the distribution revealed 77 men and 73 females in the control group and 74 males and 76 females in T2DM.The body mass index, waist-hip ratio, FBS, and PPBS levels were significantly increased inT2DM patients compared to healthy controls ($p= 0.04$, $p = 0.02$, $p<0.001$, $p<0.001$), respectively. Serum level of adiponectin was low in T2DM patients compared to healthy controls, and the difference was statistically significant ($p=0.003$).However, there was no significant difference in waist circumference(Table 1).

Table 1: Mean of clinical and anthropometric parameters of T2DM and control group

Parameters	T2DM n=150	Control n=150	p-value
Age (years)	48.89±8.81	48.43±8.86	0.65
Gender (M/F)	74/76	77/73	0.72
BMI (kg/m^2)	24.67±3.69	23.90±2.70	0.04*

Waist circumference (CM)	93.06±10.54	90.97±9.40	0.07
Waist-Hip Ratio	0.96±0.07	0.94±0.05	0.02*
FBS (mg/dl)	230.49±89.09	80.88±10.35	<0.001*
PPBS (mg/dl)	291.59±90.40	128.66±12.65	<0.001*
Adiponectin (µg/ml	4.96±3.07	5.97±2.85	0.003*

Values are expressed as Mean± Standard Deviation
*Statistically Significant as p<0.05.
BMI= body mass index, FBS= fasting blood sugar, PPBS= postprandial blood sugar

Serum adiponectin has a significant negative correlation with BMI and FBS (r= -0.178; p=0.029, r=-0.196; p=0.016), respectively. Serum adiponectin has shown a positive correlation with waist-hip ratio and a negative correlation with waist circumference (r=0.007; p=0.933, r=-0.085; p=0.300), respectively, but the correlation was not significant (Table 2).

Table 2: Correlation between serum adiponectin levels and other parameters in T2DM

Parameters → ↓	Adiponectin Pearson correlation (r_p)	p-value
BMI	-0.178	0.029*
WC	-0.085	0.300
WHR	0.007	0.933
FBS	-0.196	0.016*

*Correlation is significant at the 0.05 level (2-tailed)
BMI= body mass index, WC = Waist circumference,WHR=Waist-Hip Ratio, FBS= fasting blood sugar

Discussion

The probable involvement of fatty tissue in developing diabetes complications has received much attention over the past few years. This research aims to investigate the correlation between adiponectin, traditional and alternative risk factors, and anthropometric parameters in T2DM. Adiponectin is an adipocytokine that is secreted by adipose tissue and controls the metabolism of glucose and fats. Low levels of this adipocytokine suggest that T2DM is likely to be developing. Additionally, it will probably have a significant impact on T2DM's pathogenesis.(21) Recent meta-analysis by Li et al. has shown a strong inverse relationship between plasma adiponectin levels and the high incidence of T2DM. A higher level of adiponectin seems to indicate a lower risk of T2DM. Adiponectin is among the most reliable biochemical markers of T2DM.(22)

In the present cross-sectional study, we measured the BMIof T2DM patients, which wassignificantly higher than healthy controls.Pradhan AD et al. [21]and Ganz ML et al. reported a similar observation.(23) The present study shows that WHR was higher in T2DM than in the control subjects. The same result was found byRojen Singh S et al.(24)Serum level of adiponectin was low in T2DM patients compared to healthy controls, and the

difference was statistically significant (p=0.003). The finding is similar toRojen Singh S et al.(24)and Choudhary R(25).In contrast to previous research findings, serum adiponectin levels were not significantly connected with age, the duration of diabetes, glucose levels, or insulin levels. Instead, serum adiponectin levels were found to be adversely correlated with BMI and HbA1C levels.(26)

According to K. V. H et al.(27),estimating the blood adiponectin levels in people with newly diagnosed type 2 diabetes mellitus helps detect diabetic nephropathy early on. Because patients with newly diagnosed type 2 diabetes mellitus have elevated blood adiponectin levels, these levels positively correlate with the FBS.In our present correlation study,serum adiponectin shows a significant negative correlation with BMI and FBS. Serum adiponectin has shown a positive correlation with waist-hip ratio and a negative correlation with waist circumference,but the correlation was not significant in T2DM.Singh SR et al.(28) observed a significant negative correlation between BMI and waist-to-hip ratio. While a negative correlation between Adiponectin and FBS was statistically insignificant.It is unclear how obesity causes a decrease in adiponectin production in people. Because adiponectin is activated by insulin and blocked by TNF-α, insulin resistance, and increased TNF-α expression may be a factor in this effect. Because it interferes with insulin receptor activation, TNF-α, which is generated by white adipose tissue, is increased significantly in obesity.(29)

Limitation

There are some limitations to this study. First and foremost, our study had a small sample size. A larger sample size is required to draw more accurate conclusions. Second, the normal range for adiponectin in healthy populations has not yet been determined on an epidemiological scale. Even though adiponectin imbalance is seen in diabetes and obesity, the lack of a normal range for this parameter makes it more challenging to use as an individual case biomarker for obesity and T2DM.

Conclusion

The current study found that T2DM patients have lower adiponectin levels than the healthy control group. FBS and BMI were all negatively correlated with serum adiponectin.Higher levels of adiponectin are assumed to be associated with a lower risk of developing type 2 diabetes, which may be used as a biomarker for the diagnosis.

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