International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 13, No. 10, October 2024 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_13.10.2024.170

ORIGINAL RESEARCH

A case-control study conducted at a hospital using adiponectin as a biomarker of metabolic syndrome

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Received Date:16 August, 2024 Accepted Date:19 September, 2024 Published Date:20 October, 2024

ABSTRACT

Background: Metabolic syndrome (MetS) individuals had lower levels of adiponectin. Adiponectin may thus be a helpful marker for the early detection of metabolic syndrome. Adiponectin as a MetS marker has been used in a small number of Indian research. **Objective:** To study the correlation of adiponectin with other markers of metabolic syndrome. **Methods:** 110 patients with MetS and eighty healthy controls participated in a hospital-based case control study. A thorough history, anthropometry, and clinical examination were performed. Enzymatic techniques were used to evaluate the fasting blood sugar and lipid profile. The Friedewald method was used to compute low density lipoprotein cholesterol, and an ELISA kit was used to measure serum adiponectin. **Results:** The mean body mass index, waist circumference, weight, fasting blood sugar, total cholesterol, serum triglycerides, were significantly higher in cases compared to controls ($p<0.05$). Serum HDL and serum adiponectin were significantly lower in cases compared to controls ($p<0.05$). **Conclusion:** The clinical manifestation of the metabolic syndrome is intimately linked to hypoadiponectinemia, and the metabolic syndrome may be diagnosed by detecting the plasma concentration of adiponectin.

Key words: Adiponectin, correlation, metabolic syndrome, lipid profile

INTRODUCTION

Visceral fat syndrome and syndrome X are other names for metabolic syndrome. It is a group of disorders which include resistance to insulin, obesity and the risk factors of cardiovascular disease. A key component of the metabolic syndrome is obesity. It has been said, therefore, that not everyone who has abdominal obesity will have it.(1)

Metabolic syndrome (MetS) affects 15–40% of people worldwide. Although it is often underreported, it has been proven to be more common in underdeveloped nations. As a result, it is a significant public health issue. Individuals having metabolic syndrome are five times more at risk of developing diabetes and two times more risk of developing cardiovascular disease. (2)

The adipose tissues generate and release adiponectin. It's an adipokine. It has certain significant properties, including as anti-inflammatory, anti-diabetic, and anti-atherogenic properties. Its cardioprotective properties are widely established. (3, 4) Obese people have lower amounts of adiponectin and, concurrently, lower expression of this protein. (5)

The National Cholesterol and Education Program (NCEP)'s Adult Treatment Panel III (ATPIII) criteria for MetS state that any three of the following traits must be present: dysglycemia, low plasma HDL-C (high-density lipoprotein cholesterol), elevated triglycerides (TG), elevated blood pressure, and abdominal obesity (AO).

There is international agreement on using the ATPIII criteria. However, the cut-off values of waist circumference differ by ethnicity, country, and region. (6)

People with metabolic syndrome have increased risk of type 2 diabetes mellitus, coronary heart disease and

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other cardio metabolic diseases. India has the highest number of people with type 2 diabetes mellitus i.e. 41 million. Every fifth person with type 2 diabetes worldwide is from India. By 2030, this figure is anticipated to reach 82 million. (7, 8)

Those with metabolic syndrome are at an increased risk of atherosclerotic cardiovascular disease (ASCVD). It consists of an atherogenic dyslipidemia, elevation of blood pressure and glucose, prothrombotic and pro-inflammatory states. There is double the risk of atherosclerotic cardiovascular disease in people with metabolic syndrome compared to people without the metabolic syndrome. There are multiple pathways for the development of atherosclerotic cardiovascular disease in people with the metabolic syndrome. Compared to healthy controls, those with type-2 diabetes mellitus have higher levels of highly sensitive C reactive protein and at the same time low levels of adiponectin. (9)

As mentioned above, the adiponectin levels are decreased in patients with metabolic syndrome. Adiponectin may thus be a helpful marker for the early detection of metabolic syndrome. Moreover, there are few studies from India using adiponectin as a marker of metabolic syndrome. Therefore, present study was carried out to study the correlation of adiponectin with other markers of metabolic syndrome.

MATERIAL AND METHODOS

A single-center, hospital-based case control research including 110 patients with metabolic syndrome and 110 healthy controls was conducted at the Department of General Medicine.

According to Yosaee S. et al. (10), the mean adiponectin levels in those with metabolic syndrome were 4.85+1.8, whereas those without the condition were 8.24+4.1. The sample size for each group was determined by taking these numbers and calculating the 96% confidence level, 81% power, and 1:1 case to control ratio. Nevertheless, we managed to include 110 examples and 110 controls.

The institutional research and ethics committee granted ethical approval (No. 2016/I-F-CT-01/006). All research participants gave their written informed permission.

According to the ATP III 2001 criteria, the case definition included any three of the following.

1. Increased triglycerides: > 150 mg/dl, waist circumference: men > 102 cm, ladies > 88 cm,
2. Lower HDL cholesterol: less than 40 mg/dl in men and less than 50 mg/dl in women
3. Elevated blood pressure (BP): diastolic blood pressure > 85 mmHg or systolic blood pressure > 130 mmHg, or while receiving medication,
4. Elevated fasting blood glucose: more than 100 mg/dl. Age, sex, and socioeconomic level matched those of non-obese people without metabolic syndrome served as controls.

People who were willing to participate and were between the ages of 20 and 60 were included. The current research excluded participants with type-1 diabetes mellitus, those on thiozolidinediones, insulin treatment, anti-inflammatory medications, ACE inhibitors, ARBs, liver and renal failure, and those who were severely unwell.

A regular sphygmomanometer was used to monitor blood pressure while the subject's right arm was supine.

The body weight in kilogrammes was divided by the square of the height in square meters to get the body mass index, or BMI. After taking aseptic measures, five millilitres of blood were drawn from each participant and placed into a simple and grey top vacutainer. The blood was centrifuged for ten minutes at 4500 rpm, and the plasma and serum were separated after twenty minutes.

Low density lipoprotein cholesterol was computed using the Friedewald formula, serum adiponectin was measured using an ELISA kit, and fasting blood sugar and lipid profile were determined using enzymatic techniques.

Statistical analysis

The information was presented as means and proportions together with the standard deviation. The t test was used to compare the means of two groups, and the analysis of variance test was used to compare the means of more than two groups. To investigate the connection, the Pearson correlation coefficient was computed. Statistical significance was defined as a probability value of less than 0.05.

RESULTS

Table 1: Age and sex distribution of the study group

Characteristics	Case	Control	P value
Age	52.04±9.7	49.89±9.65	0.122
Sex(F:M)	38:44	35:47	

The mean age was not significantly different in cases and controls. The female to male ratio was also not significantly different in them. As they were matched for age and sex, they were similar for age and sex. (Table 1)

Table 2: Comparison of various parameters in cases and controls

Parameters	Cases	Controls	P value
BMI(kg/m^2)	28.76±4.81	27.27±3.63	**0.005**
Waist Circumference(cm)	103.79±7.9	94.60±9.16	**0.001**

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Height(cm)	164.07±9.9	161.64±8.07	0.262
Weight(kg)	74.55±9.53	69.97±10.66	**0.002**
FBS(mg/dl)	111.34±35.19	84.3±12.05	**0.001**
Serum Urea(mg/dl)	31.32±5.72	29.38±7.05	0.291
Serum Creatinine (mg/dl)	0.807±0.199	0.879±0.157	0.234
Total Cholesterol(mg/dl)	165.33±40.65	149.82±35.4	**0.008**
Triglycerides(mg/dl)	163.23±61.23	118.64±41.98	**0.0001**
HDL(mg/dl)	37.92±8.8	42.42±8.81	**0.0004**
LDL(mg/dl)	97.20±30.22	87.30±34.61	0.064
Serum Adiponectin(ug/ml)	3.42±0.84	8.53±0.95	**0.0001**

The mean body mass index, waist circumference, weight, fasting blood sugar, total cholesterol, serum triglycerides, were significantly higher in cases compared to controls ($p<0.05$). Serum HDL and serum adiponectin were significantly lower in cases compared to controls ($p<0.05$).

Other parameters like height, serum urea, serum creatinine, and serum LDL were not significantly different among the cases and the controls ($p>0.05$). (Table 2)

Table 3: Correlation of serum adiponectin with components of metabolic syndrome

Components of metabolic syndrome	Correlation coefficient (r)	P value
Waist circumference (cm)	-0.807	<0.05
Fasting plasma glucose (mg/dl)	-0.577	<0.05
Triglycerides (mg/dl)	-0.299	<0.05
HDL (mg/dl)	0.563	<0.05

The serum adiponectin was found to be significantly correlated with all components of metabolic syndrome ($p<0.05$). It was negatively correlated with waist circumference, fasting plasma glucose and triglycerides, whereas it was positively correlated with HDL. (Table 3)

Table 4: Comparison of adiponectin across different categories of body mass index

	Normal weight	Over weight	Obese	P value
Age	46.12±12.8	51.5±11.03	48.39±12.41	0.647
Sex (F:M)	27:29	22:33	25:30	0.666
BMI (kg/m^2)	23.7±2.461	28.82±2.511	33.02±8.91	**<0.001**
Waist circumference (cm)	94.1±8.21	101.52±8.07	107.7±8.91	**<0.023**
Adiponectin (ug/ml)	8.210±0.41	4.395±0.94	3.843±0.144	**<0.001**

The body mass index and the waist circumference was significantly more in the obese individuals compared to overweight and the normal weight individuals. The serum adiponectin level was significantly higher among the normal weight individuals compared to the overweight and obese individuals ($p<0.05$). (Table 4)

DISCUSSION

The mean age of the patients and controls in this research did not vary substantially. Additionally, there was no discernible difference in the ratio of males to females. They were comparable in terms of age and sex since they were matched for both. Cases had substantially greater mean body mass index, weight, waist circumference, fasting blood sugar, total cholesterol, and serum triglycerides than controls ($p<0.05$). Cases had substantially lower levels of serum HDL and serum adiponectin than controls ($p<0.05$). There was no significant difference between the patients and the controls in other measures such as height, serum urea, serum creatinine, and serum LDL ($p>0.05$). All elements of the metabolic syndrome were shown to have a strong correlation with serum adiponectin. ($p<0.05$) It had a favourable correlation with HDL and a negative correlation with triglycerides, fasting plasma glucose, and waist circumference. Individuals who were obese had considerably higher waist circumferences and body mass indices than those who were overweight or of normal weight. Those who were normal weight had a considerably greater blood adiponectin level than those who were overweight or obese ($p<0.05$).

Following an oral glucose tolerance test, 110 guys without diabetes had their blood adiponectin levels measured by Rubin D. et al. (11) Two hours after administering a glucose load and five to six hours after administering a lipid load, they saw a significant decrease. Following a mixed lunch, serum adiponectin showed a strong connection with the metabolic syndrome components. When serum adiponectin was associated after fasting levels, this association was less noticeable. Additionally, they discovered that triglycerides independently predicted serum adiponectin levels after multivariate analysis. The scientists came to the conclusion that

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there is a substantial correlation between postprandial triglycerides and postprandial adiponectin.

2072 guys were monitored for 13 years while their cholesterol levels in small and big low density lipoprotein sub-fractions were assessed by St-Pierre AC et al. (12). 262 patients were determined to have ischaemic heart disease. During the first seven years of follow-up, the authors discovered an independent correlation between LDL-C < 255 A levels and IHD. No relationship of any type was detected for values of this marker over this cutoff.

Ryo M et al. recruited 182 girls and 479 guys between the ages of 43 and 66. Serum adiponectin was shown to be negatively correlated with systolic blood pressure, fasting insulin, diastolic blood pressure, triglycerides, visceral fat, and waist circumference. They discovered that serum adiponectin and high density lipoprotein had a positive connection. These results are comparable to the current study's findings. They also found that serum adiponectin dramatically dropped as the average number of metabolic syndrome components rose. Additionally, we discovered a strong correlation between the elements of metabolic syndrome and blood adiponectin levels. The scientists came to the conclusion that low blood adiponectin levels are strongly linked to the clinical phenotypes of metabolic syndrome; as a result, measuring serum adiponectin may be helpful in managing metabolic syndrome.(13)

Among 100 Asian Indian patients with diabetes and 100 matched controls without the disease, Mohan V et al. (2014) evaluated the relationship between serum adiponectin and the elements of metabolic syndrome. They discovered that, in comparison to their healthy counterparts, individuals with diabetes and those with metabolic syndrome had much lower blood adiponectin levels. Similar results that support this research were also reported by us. According to the authors' linear regression analysis, there was a significant correlation between serum adiponectin and body mass index, triglycerides, glycated haemoglobin, waist circumference, and fasting blood sugar. They discovered a negative correlation between serum adiponectin and metabolic syndrome using logistic regression analysis. Our findings were comparable as well. (14)

Ogawa Y et al. (15) examined the relationship between metabolic syndrome and serum adiponectin in 100 obese boys aged 8 to 13. Based on the percentiles of serum adiponectin, they divided this population into three groups. The prevalence of visceral fat, elevated blood insulin, elevated low density lipoproteins, and metabolic syndrome were shown to vary significantly. They discovered that the cut-off value for serum adiponectin was 6.65 mcg/ml, and the area under the curve was 0.672.

According to Arita Y et al., the healthy individuals' blood adiponectin levels varied between 1.9 and 17 mg/ml. However, they were much lower in obese people. Additionally, we discovered a strong correlation between the overweight and obese subjects and their blood adiponectin levels.(16)

The relationship between the rhesus monkeys' serum adiponectin and insulin resistance was examined by Hotta K et al. (17). They discovered that obese and diabetic monkeys had much reduced blood adiponectin levels. Additionally, they noted that blood adiponectin levels dropped during the early stages of obesity and stayed that way when diabetes developed.

CONCLUSION

The clinical manifestation of the metabolic syndrome is intimately linked to hypoadiponectinemia, and the metabolic syndrome may be diagnosed by detecting the plasma concentration of adiponectin. Serum adiponectin levels were much lower in these instances, suggesting that it is a useful potential biomarker of metabolic syndrome. To find the average level of serum adiponectin in our community, larger studies must be conducted.

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