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Role Of Serum Leptin Levels In Patients With Metabolic Syndrome In A Tertiary Care Hospital In South India

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ABSTRACT

Background: Metabolic syndrome is a spectrum of metabolic disorders that can lead to cardiovascular issues, and the risk of morbidity and mortality has significantly increased. The study aims to analyze the serum leptin levels in patients with metabolic syndrome and compare them with a disease-free population.

Methods: This cross-sectional study was conducted at the Sree Balaji Medical College and Hospital for 1.5 years. All 81 patients who fulfilled the NCEP ATP -III criteria for metabolic syndrome were selected, and informed consent was obtained from every subject. The physical examination (BMI/waist-hip ratio) or all the old records are collected. All the patients involved in the study were subjected to detailed clinical history, general and systemic examination and routine blood investigations.

Results: The study included 81 patients, 54.3% males and 45.7% females, with a mean age of 44.915.26 years, BMI of 23-24.9, religious distribution of 7.4% Christians, 84% married, education of 14.8% graduates, 43.2% skilled, 49.4% unskilled, 1.25% vegetarian, 98.8% mixed diet. 15% of participants had hypertension, 7.4% had diabetes, 11.1% had SBP >150 mg/dl, 9.9% had fasting blood glucose >126 mg/dl, and all had 150-200 mg/dl of triglyceride levels. Body mass index, blood pressure, waist circumference, triglycerides, HDL, and FBS all positively correlate with serum leptin levels.

Conclusion: Leptin has multiple biological functions that influence autonomic, cardiovascular, and kidney functions and regulate feeding and metabolism. Decreasing leptin through dietary or pharmacological intervention can reduce non-communicable diseases' prevalence.

Keywords: *Metabolic syndrome, Insulin resistance, Serum leptin levels, BMI, Blood pressure, HDL, TGL, FBS*

INTRODUCTION

The term "metabolic syndrome" refers to a spectrum of metabolic disorders which occur together. When a patient comes in with metabolic syndrome, it is common knowledge that there is a significant risk for future cardiovascular issues, such as stroke and other related conditions.[1,2] Estimation shows that 12 and 37 percent of the Asian population suffers from metabolic syndrome.[3] By the time a diagnosis of metabolic syndrome

is made, many patients have already developed these consequences, and the risk of morbidity and mortality has significantly increased. The precise reason is still a mystery, but researchers believe it may be due to a combination of factors.

Insulin resistance is often regarded as the primary contributor to the development of metabolic syndrome.[4] Accumulation of triglycerides in cardiac and skeletal muscle and stimulating glucose and triglyceride production in the liver are consequences of increased intracellular fatty acid metabolites.[5,6] This increase contributes to insulin resistance by blocking insulin-signalling pathways. An increase in adiposity is linked with an increase in the generation of cytokines that promote inflammation.[7] In addition to obstructive sleep apnea and polycystic ovary syndrome, some disorders connected with metabolic syndrome are non-alcoholic fatty liver disease, cardiovascular diseases, type 2 diabetes mellitus, hyperuricemia/gout, and fatty liver disease not caused by alcohol.[8]

Adipocytes produce leptin, which induces satiety by acting on the hypothalamus in the region known as the mediobasal nucleus. The brain loses its responsiveness to leptin when leptin is lacking or when leptin resistance develops due to a mutation in the receptor for leptin.[9,10] This, in turn, causes an increase in hunger and fat deposition, ultimately resulting in obesity. The evaluation of serum leptin levels consequently becomes an essential component in the process of formulating therapeutic regimens because obesity makes a significant contribution to the risk of developing metabolic syndrome. The circulating leptin levels are utilized as a precise measurement to quantify adiposity. Contrary to what was previously believed, leptin is not simply a hormone that signals when one is full; instead, it is involved in the progression of several metabolic illnesses. Because there is a shortage of research on the link between leptin and metabolic syndrome, this subject has been selected for investigation. Therefore, the study aims to analyze the serum leptin levels in patients with metabolic syndrome and compare them with a disease-free population.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Department of General Medicine, Sree Balaji Medical College and Hospital, Chennai, for 1.5 years (April 2021-October 2022). All 81 patients who fulfilled the NCEP ATP -III criteria for metabolic syndrome were selected, and informed consent was obtained from every subject.

Inclusion criteria

Patients of >25 years of age, both male and female patients, patients with obesity (Waist circumference >102 cm in males and >88 in females), hypertension 130/85 mg/dl, FBS >100 mg/dl, Triglycerides >150 mg/dl, low HDL of <40 mg/dl for men and <50 mg/dl in women were included.

Exclusion criteria

Patients <25 years of age, patients with psychiatric problems that cause overeating, drugs that cause weight gain such as Anti-depressants, Corticosteroids, Oral Contraceptives etc., and pregnant and lactating females were excluded.

The physical examination (BMI/waist-hip ratio) or all the old records are collected. All the subjects involved in the study were subjected to detailed clinical history, general and systemic examination and routine blood investigations. Safe data storage was ensured by keeping the patient's details confidential.

Qualitative variables were assessed in frequencies and percentages. The Pearson correlation method evaluated the association between the variables. Differences in parametric distribution between the variables were assessed.

RESULTS

The study included 81 patients, of which 54.3% were males and 45.7% were females. The mean age of the study participants was 44.91±5.26 years. The majority of the participants (77.8%) were in the age group of 41-50 years, followed by 31-40 years (14.8%) and 25-30 years (7.4%). The BMI of the participants was also recorded, and it was found that 53.1% had a BMI of around 23-24.9, 33.3% had a BMI between 25-29.9, and 13.5% had a BMI between 30-35.

76.5% belonged to joint families, and 23.5% belonged to nuclear families. The religious distribution of the participants was 7.4% Christians, 87.7% Hindus, and 4.9% Muslims. 84% of the participants were married, and 16% were unmarried.

Regarding education, 14.8% of the participants were graduates, 48.1% studied till higher secondary, 13.6% studied till primary class, and 18.5% studied till secondary class. 43.2% of the participants were skilled, 49.4% were unskilled, 1.25% were vegetarians, and 98.8% had a mixed diet (Table 1).

TABLE 1: Demographic data of the study

		Frequency	**Percentage**
Gender	Male	44	54.3
	Female	37	45.7
Age group	25-30	6	7.4
	31-40	12	14.8
	41-50	63	77.8
BMI	23-24.9	43	53.1
	25-29.9	27	33.3
	30-35	11	13.5
Type of family	Joint family	62	76.5
	Nuclear family	19	23.5
Religion	Christians	6	7.4
	Hindus	71	87.7
	Muslim	4	4.9
Married status	Married	68	84
	Unmarried	13	16
Educational status	Graduates	12	14.8
	Higher Secondary	39	48.1
	Illiterate	3	3.7
	Postgraduate	1	1.2
	Primary	11	13.6
	Secondary	15	18.5
Occupational status	IT	2	2.5
	Professional	2	2.5
	Skilled	35	43.2
	unemployed	2	2.5
	Unskilled	40	49.4
Nutritional status	Veg	1	1.2
	Mixed	80	98.8
Hypertension	Present	12	15
	Absent	69	85
Diabetes mellitus	Present	6	7.4
	Absent	75	92.6
Systolic blood pressure	>150 mg/dl	9	11.1
	<150 mg/dl	72	88.9
Diastolic blood Pressure	>90 mg/dl	9	11.1
	<90 mg/dl	72	88.9
Waist circumference	>102 cm in males	44	54.3
	>88 cm in females	37	45.7
FBS	>126	8	9.9
	110-126	6	7.4
	100-110	67	82.7
Triglycerides	>200	0	0
	150-200	81	100
HDL	<40 mg/dl for men	44	54.3
	<50 mg/dl for women	37	45.7

15% of the study participants had hypertension, and 7.4% had diabetes. Among the participants, 11.1% had systolic blood pressure (SBP) >150 mg/dl, and 88.9% had SBP <150 mg/dl. 11.1% had diastolic blood pressure (DBP) >90 mg/dl, and 88.9% had DBP <90 mg/dl.

Among the participants, 9.9% had fasting blood glucose (FBG) >126 mg/dl, 7.4% had FBG between 110-126 mg/dl, and 82.7% had FBG between 100-110 mg/dl.

All the study participants had 150-200 mg/dl of triglyceride levels. 54.3% of men had HDL levels <40 mg/dl, and 45.7% of women had HDL levels <50 mg/dl (Table 1).

TABLE 2: Correlation of biochemical parameters with serum leptin levels

Variables	r (Pearson correlation)	p-value
BMI	0.229	0.04
SBP	0.598	<0.001
DBP	0.375	0.001
Waist circumference	0.289	0.009
TGL	0.359	0.001
HDL	-0.227	0.04
FBS	0.718	<0.001

Body mass index was positively correlated with serum leptin levels (r=0.229, p=0.04). Systolic, diastolic blood pressure and waist circumference have a significantly positive correlation with serum leptin levels (r=0.598, p<0.001), (r=0.375, p=0.001), and (r=0.289, p=0.009).

Triglycerides, HDL, and FBS, have a positive correlation with serum leptin levels (r=0.359, p=0.001), (r=-0.227, p=0.04), and (r=0.718, p=<0.001) (Table 2, Figures 1 to 7).

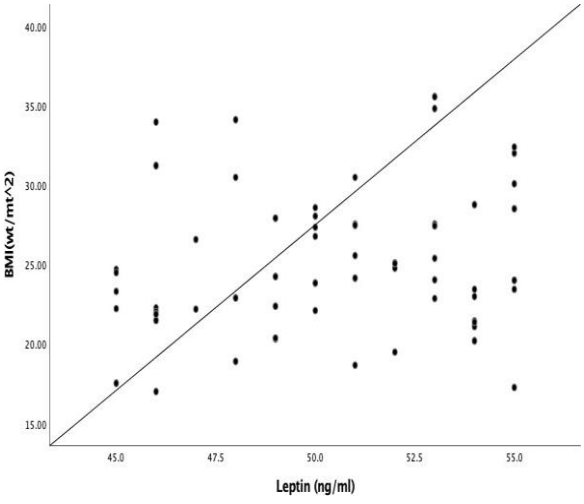

FIGURE 1: Correlation of BMI with serum leptin levels

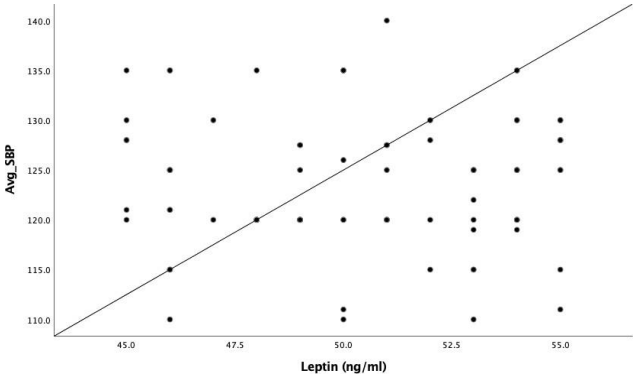

FIGURE 2: Correlation of systolic blood pressure levels with serum leptin levels

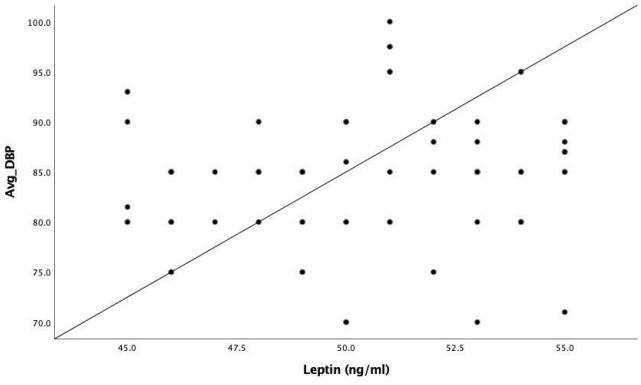

FIGURE 3: Correlation of diastolic blood pressure levels with serum leptin levels

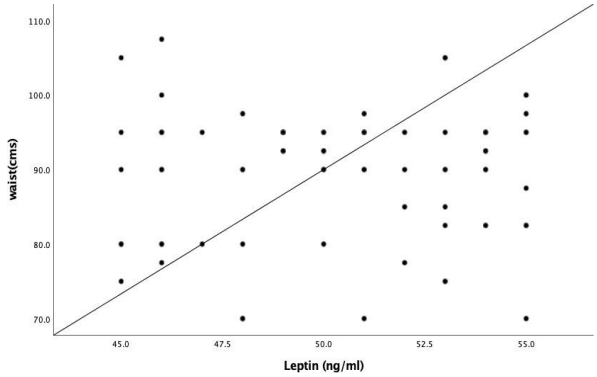

FIGURE 4: Correlation of waist circumference with serum leptin levels

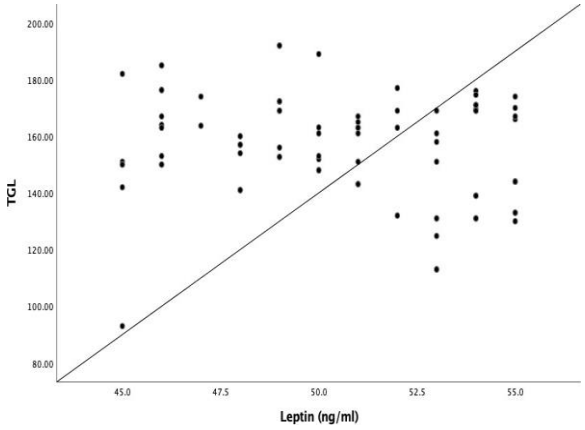

FIGURE 5: Correlation of triglycerides with serum leptin levels

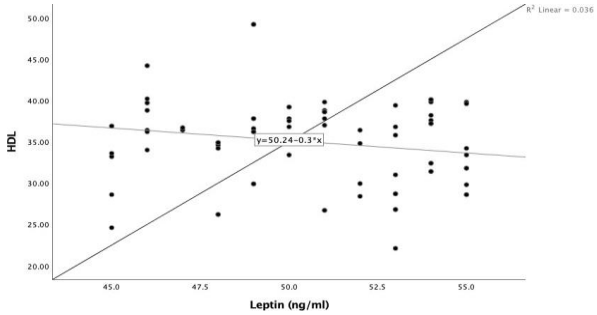

FIGURE 6: Correlation of HDL with serum leptin levels

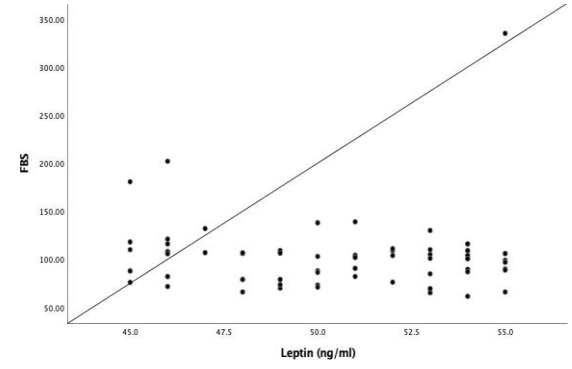

FIGURE 7: Correlation of FBS with serum leptin levels

DISCUSSION

Leptin is a protein with 167 amino acids produced by white adipose tissue, encoded by the ob gene. It is a negative appetite regulator that sends satiety signals to hypothalamic receptors. At normal concentrations, leptin regulates weight based on white fat mass, induces sodium excretion, maintains vascular tone, and repairs the myocardium. Aside from these effects, increased serum leptin levels have been linked to the development of metabolic syndrome, diabetes, hypertension, and various cardiovascular diseases.[11] Furthermore, it has been reported that hyperleptinemia contributes to renal diseases like chronic kidney disease, in which a decreased GFR characterizes a rise in albuminuria and associated clinical symptoms. Understanding the pathophysiological relationship between leptin and these cardiovascular and metabolic disorders could help physicians manage patients in the clinic. As a result, we set out to examine serum leptin levels in metabolic syndrome patients and compare them to those in the general population.[12]

In our study, the mean age of our participants was 44.91 ±5.26 years. Around 53.1% had BMI around 23 -24.9, 33.3% had 25- 29.9, 54.3% had >102 cm and 45.7% >88 cm of waist circumference. Our study shows leptin remarkably correlates with BMI, body fat, and waist circumference. Similar to research findings by Brydon L et al.[13], there is a correlation between cytokine levels and BMI in women and a negative connection between cytokine levels and leptin. Moreover, both men and women exhibit an association between plasma leptin and cardiovascular and inflammatory stress responses. According to the study by Kawashima et al.[14,] weight loss is linked to reduced adipocytokine levels, which can lower the risk of type 2 diabetes and some types of cancer. Adiponectin and leptin are valuable biomarkers for evaluating metabolic homeostasis and diet-induced weight loss. Weight loss can elevate plasma adiponectin levels, associated with enhancements in glucose, cholesterol, triglycerides, and TNF-α levels. Multiple factors like weight gain, adipose tissue distribution, consumption of a high sodium diet, hyperinsulinemia, high sympathetic drive, and RAAS stimulation have been connected with hypertension.[5]

Our study found that nearly 15% are hypertensives, 11.1% had SBP >150 mg/dl, and 88.9% of participants have SBP at <150 mg/dl. Additionally, Allison et al.[16] discovered that the link between leptin and hypertension was more robust in males. Still, no notable difference was based on race/ethnicity, BMI, or smoking status. This implies that leptin may significantly impact the onset of hypertension in men more than women. In our study, all the participants had 100% TGL 150-200 mg/dl. Neck circumference may be a better indicator of cardiovascular risk than waist circumference. Vallianou et al.[18] found a positive association between neck circumference and biomarkers of cardiovascular risk.

In certain circumstances, leptin promotes both atherosclerosis and insulin resistance. In other circumstances, however, leptin may have antiatherogenic and insulin-sensitizing effects. Under healthy conditions, these contradictory leptin effects are balanced. In pathological states like obesity, the balance of leptin's actions may stimulate inflammation, oxidative stress, and vascular smooth muscle hypertrophy. This contributes to the causation of hypertension, atherosclerosis, left ventricular hypertrophy, and type 2 diabetes. Multiple clinical research studies demonstrate that high leptin levels, independent of conventional risk factors, predict several cardiovascular diseases, including acute cardiovascular events, restenosis following coronary injury, and stroke.

CONCLUSION

Our study shows that leptin significantly correlates with Body Mass index, systolic blood pressure, diastolic blood pressure, Waist circumference, triglyceride levels, and fasting blood sugar by increasing leptin levels. Our research findings suggest that leptin has multiple biological functions that influence autonomic, cardiovascular, and kidney functions and regulate feeding and metabolism. The definitive role of leptin as a cause or effect of the metabolic effects of adipokine pattern alterations in patients with renal impairment or in the pathophysiology of metabolic or cardiovascular diseases cannot be determined. There are insufficient data to confirm whether reducing leptin in people with diabetes can reduce cardiovascular complications. Due to the small sample size of this study, the statistical difference may vary in other large group populations. Decreasing leptin through dietary or pharmacological intervention in obese individuals with metabolic syndrome can reduce non-communicable diseases' prevalence.

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