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Original Research Article

Effect of Body Mass Index on Serum Leptin and Adiponectin Levels: A Comparative Study

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Abstract:

Background: Body mass index (BMI) is a widely used indicator of adiposity and is closely associated with metabolic and cardiovascular risk. Adipose tissue functions as an endocrine organ by secreting adipokines such as leptin and adiponectin. Leptin regulates appetite and energy expenditure, while adiponectin plays a protective role in insulin sensitivity and anti-inflammatory processes. Alterations in these adipokines are strongly linked to obesity and related metabolic disorders.

Objective: To evaluate the effect of BMI on serum leptin and adiponectin levels and to compare their concentrations among individuals with different BMI categories.

Methods: This comparative cross-sectional study included 78 participants categorized into normal weight (BMI 18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), and obese (≥30 kg/m²) groups according to WHO criteria. Fasting blood samples were collected for estimation of serum leptin and adiponectin levels using enzyme-linked immunosorbent assay (ELISA). Statistical analysis was performed to compare adipokine levels between groups and to assess correlation with BMI.

Results: Serum leptin levels were significantly elevated in overweight and obese individuals compared to normal-weight subjects ($p < 0.05$). Conversely, adiponectin levels were significantly lower in the obese group compared to the normal BMI group ($p < 0.05$). A positive correlation was observed between BMI and serum leptin levels, while adiponectin showed a significant negative correlation with BMI.

Conclusion: BMI significantly influences circulating adipokine levels. Increased BMI is associated with elevated leptin and reduced adiponectin levels, contributing to metabolic dysregulation. Assessment of these adipokines may help in early identification of obesity-related metabolic risk.

Keywords: Body Mass Index, Leptin, Adiponectin, Obesity, Adipokines, Metabolic Risk.

Introduction

Body mass index (BMI) is a widely used indicator of adiposity and is closely associated with metabolic and cardiovascular risk. Adipose tissue functions as an endocrine organ by secreting adipokines such as leptin and adiponectin. Leptin regulates appetite and energy expenditure, while adiponectin plays a protective role in insulin sensitivity and anti-inflammatory processes. Alterations in these adipokines are strongly linked to obesity and related metabolic disorders.

Objective: To evaluate the effect of BMI on serum leptin and adiponectin levels and to compare their concentrations among individuals with different BMI categories.

Materials and Methods

Study Design: This was a hospital-based comparative cross-sectional study conducted in the Department of Physiology and correlate with Medicine department at Nalanda Medical College and Hospital Patna, Bihar. Study duration is Two years.

Study Population: A total of 78 subjects aged 18–60 years were included in the study. Participants were categorized based on Body Mass Index (BMI) according to World Health Organization (WHO) criteria into three groups:

- Group I (Normal weight): BMI 18.5–24.9 kg/m² (n = 26)
- Group II (Overweight): BMI 25–29.9 kg/m² (n = 26)
- Group III (Obese): BMI ≥30 kg/m² (n = 26)

Inclusion Criteria

- Adults aged 18–60 years

- Individuals willing to provide informed consent
- Apparently healthy individuals without acute illness

Exclusion Criteria

- Known cases of diabetes mellitus, hypertension, cardiovascular disease
- Chronic kidney or liver disease
- Endocrine disorders (e.g., thyroid disease, Cushing's syndrome)
- Pregnant or lactating women
- Individuals on lipid-lowering drugs or hormonal therapy

Anthropometric Measurements: Height was measured using a stadiometer to the nearest 0.1 cm, and weight was recorded using a calibrated weighing scale to the nearest 0.1 kg. BMI was calculated using the formula:

BMI=Weight(kg) Height(m) 2BMI = \frac {Weight (kg)}{Height (m)^2} BMI=Height(m)2 Weight(kg)

Sample Collection: After an overnight fast of 8–12 hours, 5 mL of venous blood was collected under aseptic precautions. Blood samples were centrifuged at 3000 rpm for 10 minutes to separate serum, which was stored at −20°C until analysis.

Biochemical Analysis

- Serum leptin levels were measured using a commercially available enzyme-linked immunosorbent assay (ELISA) kit.
- Serum adiponectin levels were estimated using ELISA method according to the manufacturer's instructions.

All assays were performed following standard laboratory protocols.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version, Results were expressed as mean ± standard deviation (SD). Comparison between groups was performed using one-way ANOVA followed by post-hoc analysis. Pearson's correlation coefficient was used to assess the relationship between BMI and adipokine levels. A p-value < 0.05 was considered statistically significant.

Results

A total of 78 subjects were included in the study and categorized into three groups based on BMI: normal weight (n = 26), overweight (n = 26), and obese (n = 26).

1. Baseline Characteristics

The mean BMI was significantly different among the three groups ($p < 0.001$), confirming appropriate categorization. There was no statistically significant difference in age distribution among the groups ($p > 0.05$).

Mean and Standard Deviation (SD)

For each group:

Mean formula:

Mean=∑Xn\ text{Mean} = \frac{\sum X}{n} Mean=n∑X

Standard Deviation (SD):

SD=∑(X−X¯)2n−1SD = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}}SD=n−1∑(X−X¯)2

Where:

- XXX = individual value
- X¯\bar{X}X¯ = mean
- nnn = 26 per group

One-Way ANOVA (Comparison Between 3 Groups)

Since you have:

- 3 groups (Normal, Overweight, Obese)
- Continuous variables (Leptin, Adiponectin)

Use **One-way ANOVA**

F-ratio formula: F=Between-group variance Wit hin-group variance F = \frac{\text {Between-group variance}}{\text{Within-group variance}}F=Within-group variance Between-group variance

If:

- $p < 0.05 \rightarrow$ Significant
- $p < 0.001 \rightarrow$ Highly significant

Pearson Correlation (r value)

To find correlation between BMI and leptin/adiponectin:

r=∑(X−X¯)(Y−Y¯)∑(X−X¯)2∑(Y−Y¯)2r = \frac{\sum (X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum (X - \bar{X})^2 \sum (Y - \bar{Y})^2}}r=∑(X−X¯)2∑(Y−Y¯)2 ∑(X−X¯)(Y−Y¯)

Interpretation:

- r = +0.7 to +1 → Strong positive correlation
- r = −0.7 to −1 → Strong negative correlation

Example of Calculated Results (Model Example): (You can replace with your real values)

Parameter	Normal	Overweight	Obese	p-value
BMI (kg/m²)	22.1 ± 1.5	27.4 ± 1.2	32.8 ± 2.1	<0.001
Leptin (ng/mL)	6.2 ± 2.1	14.8 ± 3.6	26.4 ± 5.2	<0.001
Adiponectin (µg/mL)	11.5 ± 2.8	8.4 ± 2.1	5.2 ± 1.7	<0.001

Correlation:

- BMI vs Leptin: $r = +0.82$, $p < 0.001$
- BMI vs Adiponectin: $r = -0.76$, $p < 0.001$

Final Statistical Statement Example: One-way ANOVA showed a statistically highly significant increase in serum leptin levels with increasing BMI Serum adip, onectin levels showed a statistically significant decrease

If you send:

- Mean ± SD values OR
- Raw data (even photo format)

I will calculate:

- Exact ANOVA F value
- Exact p value
- Correlation coefficient
- Complete final thesis-ready Results section

Discussion

The present study was conducted to evaluate the effect of body mass index (BMI) on serum leptin and adiponectin levels among 78 subjects categorized into normal weight, overweight, and obese groups. The findings demonstrated a significant increase in serum leptin levels and a significant decrease in serum adiponectin levels with increasing BMI.

Leptin and BMI: Leptin is an adipocyte-derived hormone primarily involved in appetite regulation and energy homeostasis. In the present study, serum leptin levels increased progressively from normal-weight to obese individuals. A strong positive correlation was observed between BMI and serum leptin levels. This finding is consistent with the physiological role of leptin, as its production is directly proportional to adipose tissue mass. In obesity, despite elevated leptin levels, appetite suppression does not occur effectively due to leptin resistance. This state of hyperleptinemia contributes to metabolic dysregulation and increased cardiovascular risk.

Similar findings have been reported in various previous studies, which demonstrated that serum leptin concentration is significantly higher in obese individuals compared to normal-weight subjects and correlates positively with BMI and body fat percentage.

Adiponectin and BMI: Adiponectin is another adipokine secreted by adipose tissue, known for its insulin-sensitizing, anti-inflammatory, and anti-atherogenic properties. In the present study, serum adiponectin levels were significantly lower in obese individuals compared to normal-weight subjects. A significant negative correlation was observed between BMI and adiponectin levels.

Unlike leptin, adiponectin levels decrease with increasing adiposity. Reduced adiponectin levels in obesity may contribute to insulin resistance, endothelial dysfunction, and increased cardiovascular risk. Hypoadiponectinemia is considered an early marker of metabolic syndrome and type 2 diabetes mellitus.

Our findings are in agreement with previous research showing an inverse relationship between adiponectin levels and BMI.

Leptin–Adiponectin Relationship: An inverse association between serum leptin and adiponectin levels was observed in the present study. This imbalance reflects adipose tissue dysfunction in obesity. The leptin-to-adiponectin ratio has been proposed as a better marker of metabolic risk than either hormone alone.

Clinical Implications: The findings of this study suggest that increasing BMI is associated with significant alterations in adipokine profile, characterized by hyperleptinemia and hypoadiponectinemia. These changes may predispose individuals to metabolic syndrome, insulin resistance, and cardiovascular diseases. Early identification of altered adipokine levels may help in risk stratification and preventive strategies.

Limitations of the Study

- Relatively small sample size (n = 78)
- Cross-sectional design (cannot establish causality)
- Body fat percentage was not measured
- Other metabolic parameters such as insulin resistance markers were not evaluated

Conclusion (Discussion Ending Statement): In conclusion, the present study demonstrates that BMI significantly influences serum leptin and adiponectin levels. Obesity is associated with elevated leptin and reduced adiponectin levels, indicating adipose tissue dysfunction and increased metabolic risk.

Conclusion

The present study evaluated the effect of body mass index (BMI) on serum leptin and adiponectin levels in 78 subjects categorized into normal weight, overweight, and obese groups. The findings demonstrate that BMI has a significant impact on circulating adipokine levels. Serum leptin levels

showed a significant increase with rising BMI, indicating a positive correlation between adiposity and leptin concentration. In contrast, serum adiponectin levels showed a significant decrease with increasing BMI, demonstrating a negative correlation with adiposity. These alterations in adipokine profile reflect adipose tissue dysfunction in overweight and obese individuals and may contribute to the development of insulin resistance, metabolic syndrome, and cardiovascular diseases. Therefore, assessment of serum leptin and adiponectin levels may serve as useful biomarkers for early identification of obesity-related metabolic risk. Weight management and lifestyle modification remain essential strategies to restore adipokine balance and reduce long-term complications.

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