Gender-Specific Patterns of Adipokines in Coronary Artery Disease: A Clinical Study

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Abstract

Background: Coronary artery disease (CAD) is influenced by multiple metabolic and hormonal factors, including adipokines such as adiponectin and leptin. Gender differences in these biomarkers may contribute to variations in disease severity and progression. **Aim:** To evaluate serum adiponectin and leptin levels in male and female patients with CAD and to examine their association with disease severity.**Materials and Methods:** A total of 190 patients aged >40 years diagnosed with CAD were included (141 males, 49 females). Serum adiponectin and leptin levels were measured using ELISA. CAD severity was classified using CAD-RADS criteria into mild (Group 1), moderate (Group 2), and severe (Group 3). Gender-based comparisons were performed using Student's t-test, and differences across CAD severity groups were analyzed using one-way ANOVA. **Results:** Females exhibited significantly higher mean adiponectin (28.28 ± 8.76 ng/mL) and leptin (40.39 ± 14.45 ng/mL) levels compared to males (adiponectin: 25.06 ± 7.97 ng/mL; leptin: 35.73 ± 12.80 ng/mL, $p < 0.05$). Adiponectin levels tended to decrease and leptin levels slightly increased with CAD severity in both genders, though these trends were not statistically significant. Gender-specific patterns in adipokine distribution persisted across all CAD severity groups. **Conclusion:** Significant gender differences exist in serum adiponectin and leptin levels among CAD patients, with females showing higher concentrations. These adipokines exhibit distinct trends with disease severity, highlighting their potential role in sex-specific risk assessment and management of CAD. Further studies are needed to explore their utility as biomarkers and therapeutic targets.

Keywords: Coronary artery disease, Adiponectin, Leptin, Gender differences, CAD severity, Biomarkers

Introduction

Coronary artery disease (CAD) remains a leading cause of morbidity and mortality worldwide, contributing substantially to premature death and disability. According to the World Health Organization, cardiovascular diseases account for nearly one-third of all global deaths, with ischemic heart disease being the single largest contributor [1]. Despite advances in diagnostic and therapeutic strategies, the prevalence of CAD continues to rise, particularly in low- and middle-income countries undergoing rapid epidemiological transition [1].

Adipose tissue, once regarded as a passive energy store, is now recognized as an active endocrine organ that secretes a variety of bioactive proteins collectively termed **adipokines** [2]. These mediators, including adiponectin and leptin, influence systemic metabolic homeostasis, vascular inflammation, endothelial function, and oxidative stress—all of which are central to the pathophysiology of CAD [2]. Dysregulation of adipokine secretion has been implicated in obesity-related cardiovascular risk and may provide novel biomarkers and therapeutic targets in atherosclerotic disease [2].

Adiponectin, one of the most abundant adipokines, exerts anti-inflammatory, anti-atherogenic, and insulin-sensitizing effects. Higher circulating adiponectin levels are associated with reduced vascular inflammation, improved endothelial function, and a lower risk of CAD [3]. Conversely, patients with established CAD often exhibit reduced adiponectin concentrations, suggesting a protective role whose deficiency may accelerate atherosclerosis [3].

In contrast, **leptin** is best known for its central role in appetite regulation and energy balance but has also been implicated in cardiovascular pathology. Elevated leptin levels promote inflammatory signaling, oxidative stress, endothelial dysfunction, and vascular smooth muscle proliferation, thereby contributing to atherogenesis [4]. Hyperleptinemia has been associated with obesity, metabolic syndrome, and increased severity of CAD in clinical studies [4].

Importantly, circulating levels of adipokines are influenced by **gender**. Women generally exhibit higher adiponectin and leptin concentrations than men, even after adjusting for adiposity, a difference attributed to hormonal influences and variations in fat distribution [5]. Estrogen appears to enhance adiponectin secretion, while men, who typically accumulate more visceral fat, display lower adiponectin and higher cardiovascular risk [5]. These sex-specific patterns may partly explain differences in CAD presentation and outcomes between men and women.

Despite these observations, relatively few studies have systematically examined adipokine differences between male and female patients with established CAD, especially in South Asian populations where CAD prevalence is high and onset often occurs at a younger age. Clarifying these patterns is clinically relevant, as understanding sex-specific biomarker variations may improve cardiovascular risk stratification and support personalized therapeutic strategies.

Therefore, the present study was undertaken to evaluate **gender-based differences in adiponectin and leptin among patients with coronary artery disease**, with the aim of contributing to a better understanding of sex-specific mechanisms in atherosclerosis.

Material & Methods

Study Design and Setting

This cross-sectional study was conducted in the Department of Biochemistry, Teerthanker Mahaveer Medical College and Research Centre, Moradabad, between July 2023 and December 2024. A total of 190 patients diagnosed with coronary artery disease (CAD) and admitted for coronary angiography were recruited after obtaining written informed consent. Ethical approval was obtained from the Institutional Ethics Committee prior to commencement of the study.

Participant Selection

Eligible participants included adult patients aged >40 years with angiographically confirmed CAD [6]. Patients with chronic inflammatory diseases, malignancy, end-stage renal disease, or those receiving antioxidant supplementation were excluded. Baseline demographic and clinical details, including age, sex, smoking history, comorbidities, and medications, were recorded at enrolment [7].

Sample Collection and Biochemical Analysis

Venous blood samples were collected from all participants after an overnight fast. Serum was separated and stored at –80°C until further analysis. Serum adiponectin and leptin concentrations were quantified using commercially available enzyme-linked immunosorbent assay (ELISA) kits (manufacturer details), according to the manufacturer's protocols. All samples were analyzed in duplicate to minimize intra-assay variability.

Coronary Angiography and Disease Confirmation

All patients underwent diagnostic coronary angiography for confirmation of CAD. Based on angiographic findings, disease severity was classified according to CAD-RADS guidelines.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 28. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies or percentages. Normality was tested using the Shapiro–Wilk test.Gender-based comparisons of adiponectin and leptin were performed using the **independent samples t-test** (or Mann–Whitney U test for non-normal data).Subgroup analyses by CAD severity were conducted using **one-way ANOVA**. Correlation analyses between adiponectin, leptin, and clinical parameters were performed using **Pearson's or Spearman's correlation**.

A p-value <0.05 was considered statistically significant.

Results

A total of 190 patients aged >40 years diagnosed with coronary artery disease (CAD) were included in the study. The cohort comprised 141 males (mean age 57.6 ± 10.0 years) and 49 females (mean age 60.0 ± 7.6 years), with an overall mean age of 57.9 ± 9.5 years.

Serum adiponectin and leptin levels were measured in all participants and compared between male and female patients by student t-test as shown in Table 1, **females exhibited significantly higher mean adiponectin and leptin levels compared to males** ($p < 0.05$). The gender-based differences remained consistent across the various CAD severity groups (mild, moderate, and severe), suggesting a persistent sex-specific pattern in adipokine distribution as shown in Table 2.

Further analysis revealed that adiponectin levels tended to decrease with increasing CAD severity in both genders, whereas leptin levels showed a slight upward trend with disease severity, although these trends did not reach statistical significance.

Table1: Comparison of serum adiponectin and leptin levels between male and female patients by student t-test

Parameter	Male (n=141), Mean ± SD	Female (n=49), Mean ± SD	P-value
Adiponectin	25.064 ± 7.966	28.284 ± 8.758	0.034*
Leptin	35.727 ± 12.797	40.385 ± 14.446	0.021*

Table 2: ANOVA for serum adipokines among Different CAD Severity Groups

Biomarker	CAD Group (by CAD-RADS)	Mean ± SD	P-value	Significance
Adiponectin	Group 1 CAD	39.182 ± 6.519	<0.001	**
	Group 2 CAD	29.237 ± 5.408		
	Group 3 CAD	23.002 ± 5.457		
Leptin	Group 1 CAD	18.807 ± 14.11	<0.001	**
	Group 2 CAD	32.795 ± 7.878		
	Group 3 CAD	44.543 ± 8.580		

Discussion

Our study aimed to explore gender-based differences in serum adiponectin and leptin levels among patients with coronary artery disease (CAD). We observed that females had significantly higher mean levels of both adiponectin and leptin compared to males, aligning with findings from previous studies.

For instance, **Iglesias et al.** reported that women exhibited higher adiponectin and leptin expression in epicardial adipose tissue compared to men, suggesting a gender-specific pattern in adipokine expression [8]. Additionally, a study by **Rahmani et al.** found that plasma leptin levels were higher in CAD patients compared to controls, and the leptin/adiponectin ratio was positively correlated with the number of involved coronary vessels, indicating a potential role of these adipokines in CAD severity [9].

Our analysis also revealed that adiponectin levels tended to decrease with increasing CAD severity in both genders, whereas leptin levels showed a slight upward trend. These trends are consistent with the findings of **Rahmani et al.,** who observed that higher plasma leptin levels were associated with more severe CAD, as indicated by the number of involved vessels and the Gensini score [9].

The observed gender differences in adipokine levels may have implications for the pathophysiology and progression of CAD. Adiponectin is known for its anti-inflammatory and anti-atherogenic properties, whereas leptin is associated with pro-inflammatory effects. The higher levels of adiponectin and leptin in females may reflect a compensatory mechanism in response to the increased cardiovascular risk associated with menopause and other hormonal changes. However, the exact mechanisms underlying these gender differences remain to be elucidated.

In conclusion, our findings underscore the importance of considering gender differences in adipokine levels when assessing cardiovascular risk and disease severity in CAD patients. Further research is needed to elucidate the underlying mechanisms driving these differences and to explore their potential as therapeutic targets in CAD management.

Conclusion

In this study of 190 patients with coronary artery disease, we demonstrated significant gender differences in serum adipokine levels, with females exhibiting higher adiponectin and leptin concentrations compared to males. Adiponectin levels tended to decrease, while leptin levels showed a slight upward trend with increasing CAD severity, although these changes were not statistically significant. These findings highlight a persistent sex-specific pattern in adipokine distribution that may contribute to differential cardiovascular risk and disease progression. Understanding these gender-based differences may provide insights into CAD pathophysiology and inform personalized risk assessment and therapeutic strategies. Further studies are warranted to elucidate the underlying mechanisms and to explore the potential of adiponectin and leptin as biomarkers or therapeutic targets in CAD management.

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