International Journal of Medical Sciences And Clinical Research

VOLUME Vol.05 Issue12 2025
PAGE NO. 66-68
DOI 10.37547/ijmscr/Volume05Issue12-15

The Role Of Selenium In The Pathogenesis And Prevention Of Cardiovascular Diseases

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Received: 20 October 2025; **Accepted:** 11 November 2025; **Published:** 16 December 2025

Abstract: Background: Selenium is an essential trace element involved in antioxidant defense, inflammatory regulation, and endothelial function. Selenium deficiency has been associated with an increased risk of cardiovascular diseases (CVD), including arterial hypertension, ischemic heart disease, and acute coronary syndromes.

Objective: To assess selenium status in patients with cardiovascular diseases in Uzbekistan and to evaluate its association with clinical and biochemical parameters related to oxidative stress.

Methods: A cross-sectional observational study was conducted between 2022 and 2024 in cardiology departments in Tashkent. A total of 198 patients with various cardiovascular conditions and 40 healthy controls were enrolled. Serum selenium concentration was measured using a fluorometric method. Oxidative stress parameters and ambulatory blood pressure monitoring were assessed in selected patients.

Results: Mean serum selenium levels in CVD patients were significantly lower than in controls (79.4 ± 13.8 μg/L vs. 92.6 ± 11.2 μg/L, $p < 0.01$). Selenium deficiency was detected in 81.8% of patients. The lowest selenium levels were observed in patients with non-ST-elevation acute coronary syndrome (66.8 ± 10.9 μg/L, $p < 0.05$). Reduced selenium levels were associated with increased oxidative stress and unfavorable circadian blood pressure profiles.

Conclusion: Selenium deficiency is highly prevalent among patients with cardiovascular diseases in Uzbekistan and is associated with enhanced oxidative stress. Monitoring and correction of selenium status may represent a promising component of comprehensive cardiovascular prevention strategies.

Keywords: Selenium; cardiovascular diseases; oxidative stress; antioxidant defense; prevention.

Introduction: Cardiovascular diseases remain the leading cause of mortality worldwide and represent a major public health challenge in Central Asia, including the Republic of Uzbekistan [1,2]. Despite advances in pharmacological and interventional therapies, the burden of arterial hypertension, ischemic heart disease, and acute coronary syndromes remains high.

In addition to traditional cardiovascular risk factors, increasing attention has been paid to the role of micronutrient imbalance in cardiovascular pathophysiology. Selenium is a vital trace element incorporated into selenoproteins, such as glutathione peroxidases and thioredoxin reductases, which protect cardiomyocytes and vascular endothelium from oxidative damage [3–5].

Low dietary selenium intake, largely determined by soil selenium content, is characteristic of several regions worldwide, including parts of Central Asia [6]. Selenium deficiency may contribute to oxidative stress, endothelial dysfunction, and inflammation—key mechanisms underlying cardiovascular disease progression.

METHODS

Study Design and Population

This observational clinical and laboratory study was conducted from 2022 to 2024 in outpatient clinics and cardiology departments in Tashkent, Uzbekistan.

A total of 198 patients (112 men and 86 women, aged 40–75 years; mean age 57.9 ± 9.4 years) with cardiovascular diseases were included:

- arterial hypertension stage II–III (n = 92);
- stable ischemic heart disease (n = 68);
- non-ST-elevation acute coronary syndrome (n = 38).

The control group consisted of 40 apparently healthy individuals matched for age and sex.

Inclusion and Exclusion Criteria

All participants had resided in Tashkent or the surrounding region for at least five years. Exclusion criteria included acute infections, chronic kidney disease stage III–V, decompensated diabetes mellitus, severe liver disease, and selenium supplementation within the previous six months.

Laboratory and Clinical Assessments

Serum selenium concentration was determined using a fluorometric method with 2,3-diaminonaphthalene, according to standardized protocols [7].

Oxidative stress parameters were evaluated in a subgroup of patients using chemiluminescence analysis. Ambulatory blood pressure monitoring was performed when clinically indicated.

Serum selenium levels were classified as follows:

- optimal: 115–120 μg/L;
- moderate deficiency: 70–114 μg/L;
- severe deficiency: <70 μg/L [8].

Statistical Analysis

Statistical analysis was performed using SPSS version 26.0. Data are presented as mean ± standard error. Group comparisons were conducted using Student's t-test or nonparametric tests as appropriate. Correlations were assessed using Pearson's correlation coefficient. A p-value < 0.05 was considered statistically significant.

RESULTS

The mean serum selenium concentration in patients with cardiovascular diseases was 79.4 ± 13.8 μg/L, significantly lower than in the control group (92.6 ± 11.2 μg/L, $p < 0.01$).

Overall, 81.8% of patients exhibited selenium deficiency, including:

- moderate deficiency in 51.5%;
- severe deficiency in 30.3%.

Patients with non-ST-elevation acute coronary syndrome demonstrated the lowest selenium levels (66.8 ± 10.9 μg/L, $p < 0.05$ compared with other groups).

Lower selenium concentrations were associated with:

- increased markers of oxidative stress;
- reduced antioxidant reserve;
- a higher prevalence of unfavorable circadian blood pressure patterns ("non-dipper" and "night-peaker").

A moderate negative correlation was observed between serum selenium levels and oxidative stress indicators ($r = –0.36$, $p < 0.05$).

DISCUSSION

The present study demonstrates a high prevalence of selenium deficiency among patients with cardiovascular diseases in Uzbekistan. These findings are consistent with international studies reporting associations between low selenium status and increased cardiovascular risk [9–11].

Selenium deficiency impairs the activity of selenoenzymes involved in redox homeostasis, leading to enhanced lipid peroxidation, endothelial dysfunction, and inflammatory activation—central mechanisms in atherosclerosis and acute coronary syndromes [12,13].

Regional dietary patterns and soil selenium content likely contribute to chronic selenium insufficiency in the studied population. Therefore, selenium status may serve not only as a biomarker of nutritional adequacy but also as a potential indicator of cardiovascular risk severity.

Clinical and Preventive Implications

Correction of selenium deficiency may represent an adjunctive strategy in cardiovascular prevention. Clinical trials suggest that selenium supplementation, particularly in combination with coenzyme Q10, may reduce cardiovascular mortality and improve cardiac function in elderly populations [14,15]. However, further randomized controlled studies are required to establish optimal supplementation strategies in Central Asian populations.

CONCLUSION

Selenium deficiency is highly prevalent among patients with cardiovascular diseases in Uzbekistan and is associated with increased oxidative stress and adverse clinical profiles. Assessment and correction of selenium status may be considered a promising component of comprehensive cardiovascular prevention and

personalized patient management.

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