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**ORIGINAL RESEARCH**

# Serum Selenium Level In Chronic Obstructive Pulmonary Disease Patients In A Tertiary Care Centre In Kerala.

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**Abstract**

**Background:** Chronic Obstructive Pulmonary Disease (COPD) is a major cause of morbidity and mortality worldwide. Oxidative stress plays a critical role in its pathogenesis. Selenium, an essential trace element with antioxidant properties, is hypothesized to influence airway dysfunction in COPD.

**Objective:** To assess the serum selenium level in COPD patients visiting a tertiary care hospital and compare it with age and sex-matched controls.

**Methods:** This observational, hospital-based cross-sectional study included 29 COPD patients and 16 healthy controls. Serum selenium levels were measured using Atomic Absorption Spectroscopy (AAS) with a Flame Analysis method. Statistical comparisons were made between cases and controls using appropriate tests.

**Results:** The mean serum selenium level was significantly lower in COPD patients (76 µg/L) compared to controls (108.38 µg/L). Additionally, selenium levels were influenced by smoking status, socioeconomic background, and occupational history. Active smokers exhibited lower selenium levels (57.43 µg/L) than non-smokers (88.03 µg/L). Lower socioeconomic groups and individuals with occupational exposures, such as carpenters and quarry workers, also had significantly reduced selenium levels.

**Conclusion:** This study highlights an association between decreased serum selenium levels and COPD. Given selenium's role in antioxidant defense, its deficiency may contribute to disease progression. Further studies with larger sample sizes are needed to establish selenium as a potential biomarker for COPD and explore the benefits of selenium supplementation in disease management.

**Keywords:** COPD, Serum Selenium, Oxidative Stress, Antioxidant, Chronic Pulmonary Disease.



## Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a progressive lung disorder characterized by persistent respiratory symptoms and airflow limitation due to airway and alveolar abnormalities, primarily caused by significant exposure to noxious particles or gases[1]. It is one of the leading causes of morbidity and mortality worldwide, with an increasing prevalence in developing countries like India[2]. COPD is associated with chronic inflammation and oxidative stress, which significantly contribute to airway remodelling and lung function decline[3]. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) categorizes COPD as a major public health concern, emphasizing the need for understanding the biochemical and environmental risk factors associated with disease progression[4].

One of the key mechanisms implicated in COPD pathogenesis is oxidative stress, which results from an imbalance between oxidants and antioxidants in the

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lungs. This oxidative burden is exacerbated by environmental factors such as smoking, pollution, and occupational exposures, all of which contribute to the depletion of essential antioxidants in the body[5]. Selenium, an essential trace element, plays a vital role in antioxidant defense mechanisms by being a crucial component of glutathione peroxidase (GPx) and other selenoproteins, which protect against oxidative lung damage[6]. Studies have demonstrated that selenium deficiency can impair lung function and increase susceptibility to respiratory disorders, including COPD[7].

Despite the well-established role of oxidative stress in COPD, research investigating serum selenium levels in COPD patients remains limited. Selenium plays a fundamental role in reducing reactive oxygen species (ROS) and mitigating inflammation in pulmonary tissues. However, environmental factors such as smoking, poor diet, and occupational hazards may influence selenium levels, leading to increased vulnerability to oxidative stress-induced damage. Smoking, in particular, is known to deplete selenium stores due to its high oxidative burden, which further exacerbates lung function deterioration in COPD patients[6].

This study aims to evaluate serum selenium levels in COPD patients attending a tertiary care hospital in Kerala and compare them with age- and sex-matched healthy controls. We hypothesize that reduced selenium levels contribute to airway dysfunction and disease severity in COPD. Furthermore, this study examines the influence of smoking, occupational exposure, and socioeconomic status on selenium levels in COPD patients. The findings from this study could pave the way for further research into selenium supplementation as a potential therapeutic strategy for managing oxidative stress in COPD.

## Materials and Methods

**Study Design and Setting:** This observational, hospital-based cross-sectional study was conducted at the Pulmonary Medicine outpatient department of a tertiary care hospital in Kerala.

**Sample Size and Grouping:** A total of 50 COPD patients and 50 controls were initially considered for the study. However, after exclusions and withdrawals, the final sample size consisted of 29 COPD cases and 16 controls. Participants were grouped as follows:

- **Group 1 (Cases):** Patients diagnosed with COPD based on spirometry and clinical assessment.
- **Group 2 (Controls):** Age- and sex-matched healthy individuals without any known pulmonary disease.

Since no prior studies have examined the relationship between selenium levels and COPD, the sample size was determined on a pilot basis.

### Inclusion and Exclusion Criteria

**Inclusion Criteria:**

1. Diagnosed cases of COPD as per GOLD (Global Initiative for Chronic Obstructive Lung Disease) criteria.
2. Age-matched healthy individuals as controls.

**Exclusion Criteria:**

1. Patients with other chronic pulmonary conditions such as asthma or pulmonary fibrosis.
2. Those with systemic illnesses affecting selenium metabolism (e.g., renal or liver disease).
3. Individuals on selenium supplementation.

### Data Collection and Biochemical Analysis

- A detailed history, including smoking status, occupational exposure, socioeconomic background, and clinical profile of breathlessness, was obtained.
- Serum selenium levels were measured using Atomic Absorption Spectrometry (Model: PinAAcle 900H0)
- Ethical approval was obtained from the **Institutional Ethics Committee, Government Medical College, Thrissur** (IRC Protocol No: IEC/GMCTSR/197/2021, Date: 06.10.2021).

### Statistical Analysis

- Data were analyzed using **SPSS version 25**.
- **Descriptive statistics** (mean, standard deviation) were used for continuous variables.
- **Independent t-tests** were used to compare selenium levels between COPD patients and controls.
- A **p-value < 0.05** was considered statistically significant.

## Results

### Table 1: Comparison Between COPD Cases and Controls

The analysis of serum selenium levels between COPD patients and healthy controls revealed a significant disparity. The mean serum selenium level in COPD patients was markedly lower (**76.00 ± 5.3 µg/L**) compared to the control group (**108.38 ± 6.2 µg/L**). This difference was statistically significant (**p < 0.01**), indicating a potential role of selenium deficiency in COPD pathogenesis. The findings suggest that selenium, a crucial antioxidant, may play a protective role in lung function, and its deficiency could be linked to oxidative stress in COPD patients.

### Table 2: Influence of Smoking on Serum Selenium Levels

Smoking status was found to have a substantial impact on serum selenium levels. Active smokers exhibited the lowest selenium levels (**57.43 ± 3.9**

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**µg/L**), indicating significant depletion due to increased oxidative stress from tobacco exposure. Non-smokers had significantly higher selenium levels (**88.03 ± 4.1 µg/L**), whereas individuals who had quit smoking showed a gradual improvement in selenium levels over time (**72.7 ± 4.6 µg/L for those who quit <1 year ago, and 81.45 ± 5.1 µg/L for those who quit >1 year ago**). The differences observed were statistically significant (**p = 0.03**), reinforcing the negative impact of smoking on selenium bioavailability and the potential for recovery with smoking cessation.

**Table 3: Socioeconomic Status and Selenium Levels**

Socioeconomic background was also found to influence selenium levels. Patients from Below Poverty Line (BPL) families had lower mean selenium levels (**74.12 ± 4.8 µg/L**) compared to those from Above Poverty Line (APL) households (**82.67 ± 5.2 µg/L**). The statistically significant difference (**p = 0.04**) suggests that dietary and lifestyle factors associated with lower economic status may contribute to selenium deficiency. Given selenium's dietary dependence, individuals from lower socioeconomic groups may have limited access to selenium-rich foods, further exacerbating oxidative stress and potential disease progression in COPD patients.

**Table 4: Occupational Influence on Serum Selenium Levels**

The study also assessed the impact of occupational exposure on serum selenium levels. The findings indicated that individuals in occupations with higher exposure to environmental pollutants had significantly lower selenium levels. Carpenters exhibited the lowest selenium levels (**43.67 ± 3.2 µg/L**), followed by quarry workers (**58.5 ± 4.1 µg/L**) and labourers (**67.96 ± 4.6 µg/L**). These occupations often involve exposure to dust, chemicals, and pollutants that may contribute to increased oxidative stress and selenium depletion.

In contrast, farmers had the highest serum selenium levels (**128 ± 5.3 µg/L**), likely due to a diet rich in selenium-containing foods and reduced exposure to industrial pollutants. Other occupations exhibited moderate selenium levels (**69.86 ± 4.7 µg/L**). The differences observed were statistically significant (**p = 0.02**), reinforcing the association between occupational exposure and selenium deficiency.

**Table 1: Serum Selenium Levels in COPD Cases vs. Controls**

| Variable | No. of Samples | Mean Serum Selenium (µg/L) | P-value |
|---|---|---|---|
| Cases | 29 | 76.00 ± 5.3 | < 0.01 |
| Controls | 16 | 108.38 ± 6.2 | < 0.01 |

**Table 2: Influence of Smoking on Serum Selenium Levels**

| Smoking Status | No. of Cases | Mean Serum Selenium (µg/L) | P-value |
|---|---|---|---|
| Non-smoker | 4 | 88.03 ± 4.1 | 0.03 |
| Active Smoker | 4 | 57.43 ± 3.9 | 0.03 |
| Stopped <6 months | 0 | - | - |
| Stopped <1 year | 10 | 72.7 ± 4.6 | 0.03 |
| Stopped >1 year | 11 | 81.45 ± 5.1 | 0.03 |

**Table 3: Socioeconomic Status and Serum Selenium Levels**

| Socioeconomic Status | No. of Cases | Mean Serum Selenium (µg/L) | P-value |
|---|---|---|---|
| Below Poverty Line (BPL) | 23 | 74.12 ± 4.8 | 0.04 |
| Above Poverty Line (APL) | 6 | 82.67 ± 5.2 | 0.04 |

**Table 4: Occupational Influence on Serum Selenium Levels**

| Occupation | No. of Cases | Mean Serum Selenium (µg/L) | P-value |
|---|---|---|---|
| Carpenter | 3 | 43.67 ± 3.2 | 0.02 |
| Quarry Worker | 2 | 58.5 ± 4.1 | 0.02 |
| Laborer | 14 | 67.96 ± 4.6 | 0.02 |
| Farmer | 3 | 128 ± 5.3 | 0.02 |
| Others | 7 | 69.86 ± 4.7 | 0.02 |

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## Discussion

### Serum Selenium Levels and COPD Pathogenesis

This study provides significant evidence indicating a marked reduction in serum selenium levels among COPD patients compared to healthy controls. Selenium, an essential trace element, plays a crucial role in the body's antioxidant defense mechanisms, particularly in the regulation of oxidative stress and inflammation in pulmonary diseases[1]. COPD is a progressive disease characterized by chronic inflammation and increased oxidative stress, leading to irreversible airway remodelling and lung function decline[2]. Our findings align with previous studies that suggest low serum selenium levels may exacerbate oxidative damage, contributing to the pathophysiology of COPD[3].

Selenium is an integral component of glutathione peroxidase (GPx), thioredoxin reductase, and other antioxidant enzymes, which act to neutralize reactive oxygen species (ROS)[4]. A deficiency in selenium may impair these protective mechanisms, thereby increasing susceptibility to lung tissue damage. Lower serum selenium levels in COPD patients (76 µg/L) compared to controls (108.38 µg/L) suggest a potential link between selenium depletion and increased oxidative burden (Table 1). The persistence of chronic oxidative stress in COPD can further reduce selenium bioavailability, leading to a vicious cycle of inflammation and airway obstruction[5].

### Role of Oxidative Stress in COPD and Selenium's Antioxidant Function

COPD is associated with an imbalance between oxidant and antioxidant systems, leading to an excess production of free radicals and inflammatory mediators[6]. Smoking, environmental pollutants, and occupational exposures contribute significantly to this oxidative stress burden. Selenium's antioxidant properties protect lung tissues from ROS-induced damage, suggesting that selenium deficiency may worsen COPD progression by reducing the lung's ability to counteract oxidative stress[7].

Our study found that COPD patients had significantly lower selenium levels compared to healthy individuals, emphasizing its role in antioxidant defense. Selenium's protective effect against oxidative damage is mediated through its incorporation into selenoproteins, such as glutathione peroxidase (GPx) and selenoprotein P, which play key roles in reducing lipid peroxidation and mitigating inflammatory responses[8]. The reduction in selenium levels among COPD patients suggests increased oxidative stress and a weakened antioxidant defense, contributing to disease progression.

### Impact of Smoking on Serum Selenium Levels

The impact of smoking on selenium levels was evident in our study, where active smokers exhibited the lowest selenium levels (57.43 µg/L) compared to non-smokers (88.03 µg/L) (Table 2). Tobacco smoke contains over 7,000 harmful chemicals, including free radicals that deplete antioxidant reserves[9]. Previous research has shown that smoking reduces selenium bioavailability, potentially by altering its metabolism or increasing its excretion[10-15].

The significant decline in selenium levels among active smokers suggests that chronic exposure to cigarette smoke depletes selenium reserves, impairing the body's ability to combat oxidative stress. Interestingly, ex-smokers who had quit for more than a year showed higher selenium levels (81.45 µg/L) compared to those who had recently quit (<1 year, 72.7 µg/L), indicating a potential for selenium recovery with prolonged smoking cessation. This finding underscores the importance of reducing oxidative stress through smoking cessation and potential selenium supplementation in COPD patients.

### Socioeconomic Status and Selenium Deficiency

Our study revealed significant differences in selenium levels between socioeconomic groups, with patients from Below Poverty Line (BPL) families exhibiting lower selenium levels (74.12 µg/L) compared to Above Poverty Line (APL) individuals (82.67 µg/L) (Table 3). Selenium intake is largely dependent on dietary sources, particularly selenium-rich foods such as nuts, seafood, and whole grains[11]. Individuals from lower socioeconomic backgrounds often lack access to selenium-rich diets, predisposing them to nutritional deficiencies and increased oxidative stress.

Research indicates that dietary selenium intake is positively associated with lung function, and selenium deficiency is linked to reduced immune function and higher susceptibility to respiratory diseases[12]. This suggests that improving selenium intake through dietary modifications or supplementation could help mitigate oxidative stress and improve COPD outcomes[16-20].

### Occupational Exposure and Selenium Levels

Occupational exposure to dust, industrial pollutants, and toxic chemicals plays a critical role in the development and progression of COPD. In our study, occupational categories with higher environmental exposure, such as carpenters and quarry workers, exhibited the lowest selenium levels (43.67 µg/L and 58.5 µg/L, respectively) (Table 4). This supports existing research indicating that chronic exposure to airborne pollutants may deplete antioxidant reserves, including selenium, leading to increased lung damage[13].

Workers exposed to construction dust, silica, and industrial fumes are at a higher risk of developing COPD due to prolonged oxidative stress and inflammation[14]. Our findings suggest that occupational hazard mitigation, protective equipment, and dietary interventions to replenish antioxidant levels may be beneficial for high-risk populations[20-22].

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**Potential Therapeutic Implications of Selenium Supplementation**

Given the observed selenium deficiency in COPD patients, an important area of future research is whether selenium supplementation could improve lung function and disease outcomes. Several studies have suggested that selenium supplementation enhances antioxidant enzyme activity, potentially reducing inflammation and oxidative stress in chronic lung diseases[15].

However, selenium supplementation must be carefully monitored, as excessive intake can be toxic and lead to selenosis. Future research should focus on establishing optimal selenium levels for lung health and exploring whether targeted supplementation can slow COPD progression and improve patient quality of life.

**Study Limitations and Future Directions**

While this study provides valuable insights into serum selenium levels in COPD patients, there are several limitations:

1. Small Sample Size: This study was conducted as a pilot study with a limited number of participants. Larger studies with broader populations are needed to confirm findings.
2. Lack of Dietary Selenium Assessment: The study did not assess participants' dietary selenium intake, which could have provided additional insights into selenium status.
3. No Longitudinal Data: A cross-sectional design limits the ability to establish causality between selenium deficiency and COPD progression. Longitudinal studies are needed to examine how selenium levels fluctuate over time in COPD patients.
4. Lack of Disease Severity Correlation: The study did not stratify COPD patients based on disease severity, which could have provided additional information on the relationship between selenium levels and disease progression.

Future research should explore the therapeutic potential of selenium supplementation, examine selenium levels across different COPD severity stages, and investigate whether selenium status correlates with lung function parameters such as FEV1 and FVC.

**Conclusion**

This study demonstrates a significant reduction in serum selenium levels in COPD patients compared to healthy controls, reinforcing the role of oxidative stress and antioxidant depletion in COPD progression. The findings highlight the detrimental impact of smoking, socioeconomic status, and occupational exposures on selenium levels, suggesting the need for dietary interventions and potential selenium supplementation.

Given the growing burden of COPD in India, understanding the nutritional and environmental determinants of disease progression is crucial. This study paves the way for future research into selenium as a biomarker for COPD severity and its therapeutic role in managing oxidative stress and inflammation in affected individuals.

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