Biomedical and Biopharmaceutical Research
Abbreviation: Biomed. Biopharm. Res.
Volume: 22: Issue: 02 |Year: 2025
Page Number: 486-489

Clinical Correlation of Serum Magnesium Levels with Acute Exacerbations in Patients with Chronic Obstructive Pulmonary Disease (COPD)

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Article Received:29-06-2025

Article Accepted:20-07-2025

Abstract

Chronic Obstructive Pulmonary Disease (COPD) is a major contributor to global respiratory morbidity and mortality. Acute exacerbations (AECOPD) worsen disease progression, impair quality of life, and increase healthcare burden. Magnesium, an essential mineral, plays a key physiological role in neuromuscular activity, including bronchial smooth muscle relaxation. Recent literature has highlighted a possible association between hypomagnesemia and increased risk or severity of COPD exacerbations. This hospital-based observational study included 100 patients aged over 35 years presenting with AECOPD. Patients were clinically assessed, and serum magnesium levels were measured using a Beckman Coulter Analyzer. The study revealed that 27% of patients had serum magnesium levels below 1.0 mg/dL. A statistically significant correlation was found between lower serum magnesium levels and increased severity of exacerbations ($p < 0.0001$). These findings reinforce the hypothesis that magnesium deficiency may act as a modifiable risk factor in AECOPD. Regular monitoring and correction of magnesium levels may enhance clinical outcomes by reducing the frequency and severity of exacerbations. The study advocates for incorporating serum magnesium assessment into routine evaluation of COPD patients, especially during acute episodes.

Keywords: COPD, AECOPD, Hypomagnesemia, Serum Magnesium, Bronchial Inflammation

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive and irreversible disease characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities. It is a leading cause of morbidity and mortality globally, with acute exacerbations contributing significantly to the overall burden. Exacerbations lead to increased hospitalization, healthcare costs, and deterioration in lung function and quality of life.

Magnesium is the fourth most abundant mineral in the body and the second most prevalent intracellular cation. It plays a crucial role in a wide array of physiological processes including neuromuscular function, regulation of bronchial tone, and modulation of inflammation. Hypomagnesemia is commonly seen in chronic illnesses and is believed to be associated with enhanced disease severity in conditions such as asthma and COPD.

Despite mounting evidence supporting the role of magnesium in respiratory conditions, its association with COPD, particularly during acute exacerbations, remains underexplored. Some studies have suggested that low serum magnesium levels may exacerbate bronchial hyperresponsiveness, increase airway inflammation, and worsen respiratory muscle performance. Thus, identifying hypomagnesemia in COPD patients could provide an opportunity for targeted therapeutic intervention.

This study aims to examine the clinical correlation between serum magnesium levels and the severity of acute exacerbations in COPD patients, with the goal of evaluating magnesium as a potential biomarker and modifiable risk factor in disease management.

OBJECTIVES OF THE STUDY

1. To assess serum magnesium levels in patients with acute exacerbations of COPD.
2. To correlate these levels with clinical severity of AECOPD.
3. To evaluate whether hypomagnesemia can serve as a clinical marker for exacerbation severity.

MATERIALS AND METHODS

This hospital-based observational study was conducted over 18 months in the Department of Respiratory Medicine, Muzaffarnagar Medical College. A total of 100 COPD patients aged >35 years admitted with AECOPD were included.

Inclusion Criteria

- Patients diagnosed with COPD as per GOLD guidelines.
- Age ≥35 years.
- Patients presenting with clinical features of acute exacerbation.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Patients with chronic illnesses known to affect magnesium levels (e.g., chronic kidney disease, liver cirrhosis, malignancy).
- Patients on magnesium supplements or medications influencing magnesium levels (diuretics, aminoglycosides).
- Patients requiring ventilatory support.
- Pregnant or lactating women.

Study Procedure and Evaluation

All patients underwent detailed clinical evaluation, including history, physical examination, and spirometry. Blood samples were collected on admission to estimate serum magnesium levels using the xylidyl blue dye method on a Beckman Coulter AU analyzer. The severity of AECOPD was classified based on clinical presentation and need for hospitalization. Pulmonary function tests were assessed once patients were clinically stable. Additional parameters like length of hospital stay and symptom duration were recorded.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 20. Descriptive statistics like mean and standard deviation were used for continuous variables. Categorical variables were expressed as frequency and percentages. Chi-square test was used to evaluate the association between serum magnesium levels and AECOPD severity. A p-value of <0.05 was considered statistically significant.

RESULTS

Among 100 enrolled patients, 27% had hypomagnesemia (<1.0 mg/dL). A statistically significant correlation ($p < 0.0001$) was found between low serum magnesium levels and higher clinical severity of exacerbation. Patients with low magnesium were more likely to present with severe respiratory symptoms and longer hospital stays. These results were consistent with previously published research indicating magnesium's critical role in bronchial tone and inflammatory regulation.

Table 1: Distribution of Serum Magnesium Levels among Patients

Serum Magnesium (mg/dL)	Number of Patients	Percentage (%)
<1.0 (Hypomagnesemia)	27	27%
1.0–1.5 (Low-Normal)	48	48%
>1.5 (Normal)	25	25%

Table 2: Severity of AECOPD Based on Serum Magnesium Levels

Severity of AECOPD	Hypomagnesemia (<1.0)	Low-Normal (1.0–1.5)	Normal (>1.5)	p-value
Mild	1	05	20	
Moderate	5	38	17	<0.0001*
Severe	17	4	1	
Very Severe	04	1	00	

Figure 1: Distribution of Serum Magnesium Levels

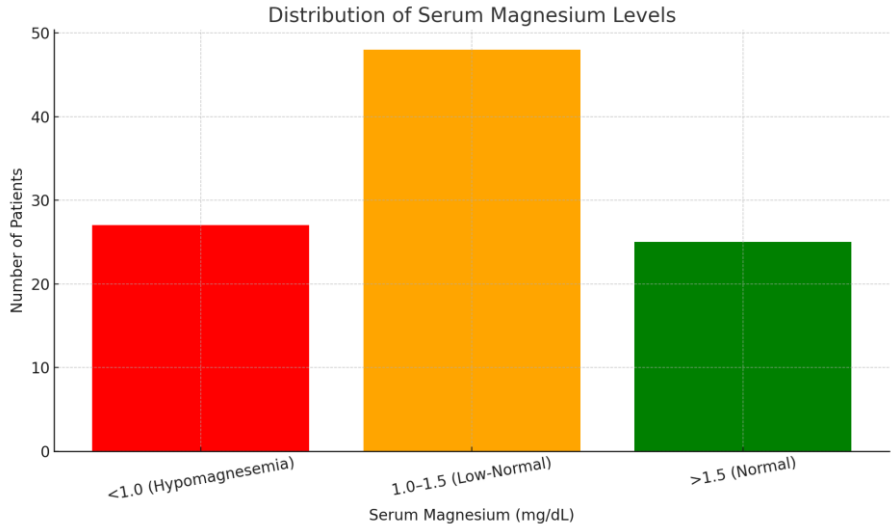
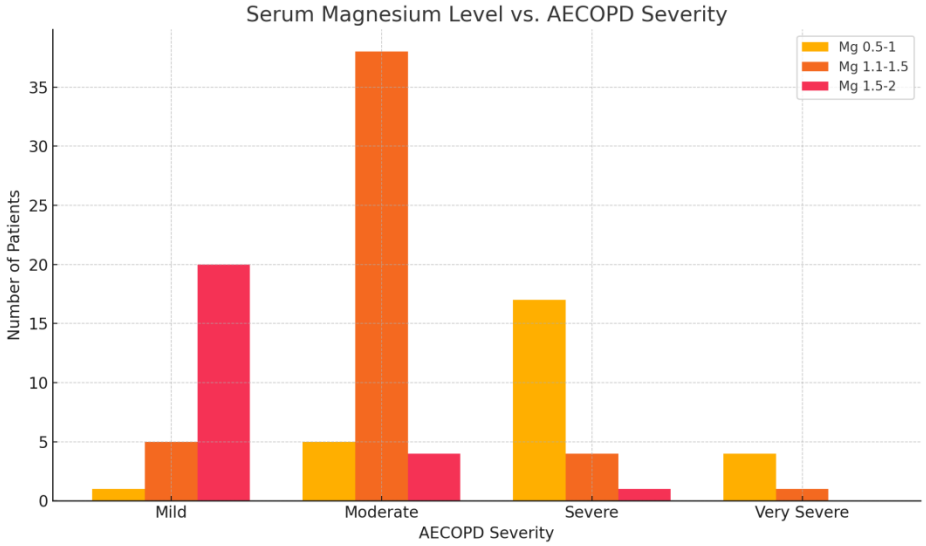


Figure 2: AECOPD Severity vs. Serum Magnesium Levels



DISCUSSION

This study demonstrates a strong association between serum magnesium levels and the severity of acute exacerbations in COPD patients. The findings reveal that hypomagnesemia is more frequently observed in patients experiencing moderate to severe exacerbations, suggesting its potential role as a biomarker for disease severity.

Previous research has highlighted magnesium's ability to modulate bronchial tone and its anti-inflammatory properties. These mechanisms are critical in maintaining airway patency and preventing exacerbations. Hypomagnesemia may contribute to airway hyperresponsiveness, reduced ciliary clearance, increased pro-inflammatory cytokine production, and impaired respiratory muscle function. Consequently, patients with low magnesium levels may be more susceptible to severe exacerbations and prolonged hospitalizations.

The present findings are in agreement with studies by Bhatt et al., Gumus et al., and Mandal et al., which demonstrated a similar correlation between low magnesium levels and exacerbation outcomes in COPD. Moreover, this study extends those observations by quantifying the burden of hypomagnesemia and stratifying its impact based on clinical severity.

It is also important to consider nutritional factors, medication use (such as diuretics or beta-agonists), and comorbidities that may influence serum magnesium levels. Addressing these contributors through nutritional support or supplementation may reduce the risk of exacerbations. Integrating serum magnesium testing into routine care for COPD patients—especially during acute episodes—could provide clinicians with a simple, cost-effective tool for prognostication and therapeutic planning.

CONCLUSION

This study confirms a statistically significant correlation between low serum magnesium levels and increased severity of AECOPD. Hypomagnesemia emerges as a potentially modifiable risk factor. Including magnesium level monitoring in routine COPD management could improve patient outcomes and reduce exacerbation-related admissions.

Future Scope

Further multi-centric and large-scale studies are warranted to validate serum magnesium as a prognostic marker. Interventional trials evaluating magnesium supplementation during exacerbations may help establish causality. Longitudinal monitoring could explore its utility in predicting long-term COPD outcomes. Integrating magnesium status assessment into COPD management guidelines could prove beneficial.

Conflict of Interest: Nil

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