



## FREQUENCY OF HYPOMAGNESEMIA IN PATIENTS WITH ACUTE EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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### Abstract

**Background:** Acute exacerbations of chronic obstructive pulmonary disease (COPD) contribute to the evolution of the disease and the cost of healthcare globally, making it a major source of morbidity and death.

**Objective:** To ascertain the prevalence of hypomagnesemia in individuals undergoing Acute Exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD) was the aim of this investigation.

**Methodology:** A cross-sectional observational design was used in this study, which took place at Lady Reading Hospital Peshawar Pakistan, from July 2021 to June 2024. The study included 400 patients who were at least 18 years old and exhibited symptoms that were consistent with acute exacerbations of COPD. Data collection included serum magnesium levels, clinical parameters, and demographic information. Descriptive statistics, prevalence estimation, and inferential tests such as logistic regression and chi-square were used in the statistical analysis to investigate hypomagnesemia predictors.

**Results:** There were 400 AECOPD patients in the trial. Among them, 313 (78.25%) were smokers, 138 (34.50%) were women, and 262 (65.50%) were men. Of the patients, 85 (21.25%) had hypomagnesemia. Hypomagnesemia was shown to be significantly correlated with age ( $p < 0.001$ ) and the severity of the exacerbation ( $p = 0.014$ ). Age ( $p < 0.001$ ) and the severity of the exacerbation ( $p = 0.014$ ) were shown to be significant predictors of hypomagnesemia by logistic regression analysis. Heart arrhythmias ( $n = 15$ ; 17.65%), neurological symptoms ( $n = 10$ ; 11.76%),

respiratory problems (n = 8; 9.41%), and other complications (n = 7; 8.24%) were among the adverse events connected to hypomagnesemia.

**Conclusion:** Our research indicates that hypomagnesemia is much more common in AECOPD patients (21.25%), underscoring the need of keeping an eye on magnesium levels, particularly in older adults and those experiencing severe exacerbations.

**Keywords:** Chronic Obstructive Pulmonary Disease, Acute Exacerbation, Hypomagnesemia, Adverse Events.

## Introduction

A major burden on healthcare systems and economies globally, chronic obstructive pulmonary disease (COPD) is one of the primary causes of morbidity and death [1]. AECOPD, or acute exacerbations of COPD, are important episodes in the disease's clinical history that often lead to hospital admissions and accelerate the disease's development [2]. The possible effect of electrolyte abnormalities, namely hypomagnesemia, on exacerbation severity and clinical outcomes has drawn attention amongst the multitude of variables that influence COPD exacerbations [3]. Magnesium, a necessary mineral with a variety of physiological functions, has potential as a modifiable risk factor for AECOPD treatment [4]. Although there has been considerable investigation into the connection between magnesium and COPD exacerbations, it is still unclear how often hypomagnesemia occurs in individuals with AECOPD [5]. This gap in information emphasizes the need of doing a thorough evaluation of the magnesium levels in this susceptible group [6].

For a number of reasons, it is critical to comprehend the incidence of hypomagnesemia in AECOPD patients [7]. First off, the pathophysiology of respiratory muscle failure, bronchial hyperreactivity, and airway inflammation are all closely related to the pathophysiology of COPD exacerbations, and magnesium shortage has been linked to these processes [8]. Second, hypomagnesemia may make pre-existing conditions including skeletal muscle dysfunction and cardiovascular illnesses worse in COPD patients, which would increase their overall sickness burden [9]. Thirdly, there may be a viable path for intervention since magnesium supplementation has shown promising therapeutic advantages in the therapy of COPD, including bronchodilation and anti-inflammatory properties [10].

Notwithstanding these ramifications, little information is currently available on the incidence of hypomagnesemia in AECOPD patients in particular [11]. Our knowledge of the full cost of hypomagnesemia in worsening COPD is limited by the fact that previous research either concentrate on stable COPD populations or completely ignore magnesium levels [12]. Our goal is to close this knowledge gap by determining the prevalence of hypomagnesemia in AECOPD patients, clarifying its clinical significance and guiding future treatment approaches.

## Research Objective

To ascertain the prevalence of hypomagnesemia in individuals undergoing Acute Exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD) was the aim of this investigation.

## Material and Methods

### Study Design and Settings

This research was carried out in the Lady Reading Hospital Peshawar, Pakistan, using a cross-sectional observational methodology. This tertiary care facility acts as a focal point for the management of a wide variety of illnesses, including exacerbations of COPD. The research term, which runs from July 2021 to June 2024, enables thorough data gathering from a variety of patient demographics and seasons.

### Inclusion and Exclusion Criteria

Participants in the research must be 18 years of age or older and have symptoms that would indicate an acute exacerbation of COPD. An abrupt worsening of respiratory symptoms necessitating further treatment is referred to as a COPD exacerbation. Enrollment consideration is given to patients whose diagnosis of COPD has been established by spirometry or clinical assessment. Patients with concomitant diseases that need rapid action, such as acute myocardial infarction or stroke, and those with insufficient medical records are considered exclusion criteria.

### Sample Size

The predicted prevalence of hypomagnesemia in patients with AECOPD is used to calculate the study's sample size. A minimum sample size of 400 patients is needed to have enough statistical power for identifying significant relationships and trends, with a 95% confidence level and a 5% margin of error.

### Data Collection

A standardized data collecting form will be used by skilled healthcare professionals to gather data. Age, gender, and smoking history are just a few of the demographic details that will be noted. Clinical parameters will be recorded, including serum magnesium levels, lung function tests, and vital signs. A check of medical records will provide further information on comorbidities, prescription drugs, and the severity of exacerbations.

### Statistical Analysis

Descriptive statistics were computed as part of the statistical analysis to compile clinical and demographic data, including serum magnesium levels. The prevalence of hypomagnesemia was calculated, and related confidence ranges were provided. After controlling for relevant confounders, inferential tests like logistic regression and chi-square examined relationships and pinpointed hypomagnesemia predictors. Subgroup analyses clarified correlations depending on exacerbation intensity, age, and gender. P values below 0.05 were regarded as significant.

### Ethical Approval

The Institutional Review Board (IRB) of the Hayatabad Medical Complex in Peshawar has granted ethical permission for this investigation, guaranteeing adherence to moral principles and patient privacy. Prior to participation, each participant will be asked for their informed permission, and during the research, precautions will be made to safeguard their privacy and other rights.

### Results

The demographic makeup of the 400 AECOPD patients in the research is shown in Table 1. Among them, 138 patients are female (34.50%), and 262 patients are male (65.50%). 313 patients (78.25%) have a history of smoking, while 87 patients (21.75%) do not smoke. About the comorbidities, there are 36 (6.50%) patients with asthma, 72 (18.00%) with coronary artery disease, 89 (22.25%) with diabetes, and 150 patients (37.50%) with hypertension.

**Table 1:** Features of Study Population's Demography

Characteristic	Number of Patients (n)	Percentage (%)
Total Patients	400	100.00
Mean Age (years)	49.2 ± 8.9	
<b>Gender</b>		
Male	262	65.50
Female	138	34.50
<b>Smoking History</b>		
Smokers	313	78.25
Non-Smokers	87	21.75

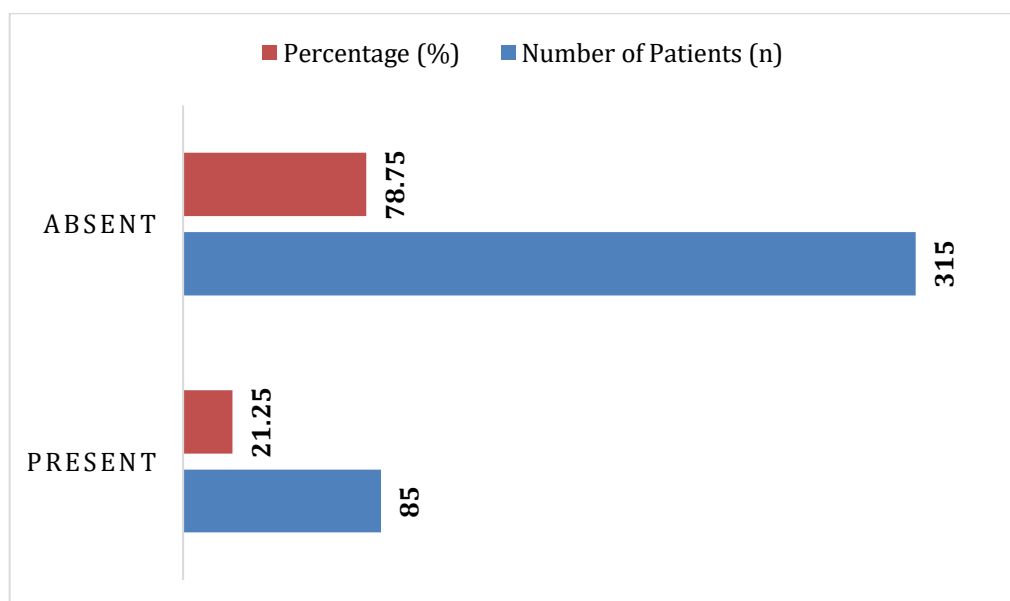
Co-morbidities		
Hypertension	150	37.50
Diabetes	89	22.25
Coronary Artery Disease	72	18.00
Asthma	38	9.50
Others	26	6.50

The clinical characteristics and serum magnesium levels of the research group are reported in Table 2. 1.9 mg/dL (SD = 0.3) is the mean serum magnesium level, and the 95% confidence interval (CI) falls between 1.7 and 2.0 mg/dL. A mean Forced Vital Capacity (FVC) of 2.5 L (SD = 0.7), a mean Forced Expiratory Volume in 1 second (FEV1) of 2.1 L (SD = 0.6), and a mean FEV1/FVC ratio of 0.83 (SD = 0.06) are further clinical measures. Furthermore, tests of arterial blood gas show a mean pH of 7.38 (SD = 0.04), a mean PaO2 of 72 mmHg (SD = 10), and a mean PaCO2 of 42 mmHg (SD = 5).

**Table 2:** Serum magnesium levels and clinical parameters

Parameter	Mean (SD)	95% CI
Serum Magnesium Level (mg/dL)	1.9 (0.3)	1.7 - 2.0
Forced Expiratory Volume in 1 second (FEV1) (L)	2.1 (0.6)	1.8 - 2.4
Forced Vital Capacity (FVC) (L)	2.5 (0.7)	2.2 - 2.8
FEV1/FVC Ratio	0.83 (0.06)	0.80 - 0.86
Arterial Blood Gas pH	7.38 (0.04)	7.36 - 7.40
Arterial Blood Gas PaO2 (mmHg)	72 (10)	70 - 74
Arterial Blood Gas PaCO2 (mmHg)	42 (5)	40 - 44

The incidence of hypomagnesemia in the study population with AECOPD is shown in Figure 1. Of the 400 patients, 85 people, or 21.25% of the group, had hypomagnesemia. On the other hand, 315 patients, or 78.75%, do not have hypomagnesemia.



**Figure 1:** Hypomagnesemia Prevalence

Table 3 shows the correlation between patient demographics and hypomagnesemia in AECOPD patients. Of the patients suffering from hypomagnesemia, 39 are younger than 55, and 46 are older than 55. This difference is statistically significant (p < 0.001). Gender-wise, hypomagnesemia is present in 52 male patients and 33 female patients, with no statistically significant correlation (p =

0.302) observed. With regard to smoking history, hypomagnesemia affects 60 smokers and 25 non-smokers; a p-value of 0.087 indicates that there is no statistically significant correlation.

**Table 3: Relationship between Demographic Factors and Hypomagnesemia**

Demographic Factor	Hypomagnesemia (n=85)	No Hypomagnesemia (n=315)	p-value
Age (years)			
<55	39	118	<0.001
≥55	46	197	
Gender			
Male	52	210	0.302
Female	33	105	
Smoking History			
Smokers	60	253	0.087
Non-Smokers	25	62	

The relationship between blood magnesium levels, hypomagnesemia, and the severity of the exacerbation in patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) is shown in Table 4. Of the people with a mild exacerbation severity, 33 have hypomagnesemia and 153 do not. This group's mean serum magnesium level is 1.8 mg/dL (SD = 0.2). On the other hand, 52 patients and 162 patients without hypomagnesemia had a significant exacerbation severity. Nonetheless, this group's mean blood magnesium level is 1.4 mg/dL (SD = 0.6). Between the groups with moderate and severe exacerbation severity, there is a statistically significant difference in mean blood magnesium levels (p = 0.014).

**Table 4: Relationship between Serum Magnesium Levels, Hypomagnesemia, and the Severity of Exacerbations**

Exacerbation Severity	Hypomagnesemia (n=85)	No Hypomagnesemia (n=315)	Mean Magnesium Level (mg/dL) (SD)	p-value
Moderate	33	153	1.8 ± 0.2	0.014
Severe	52	162	1.4 ± 0.6	

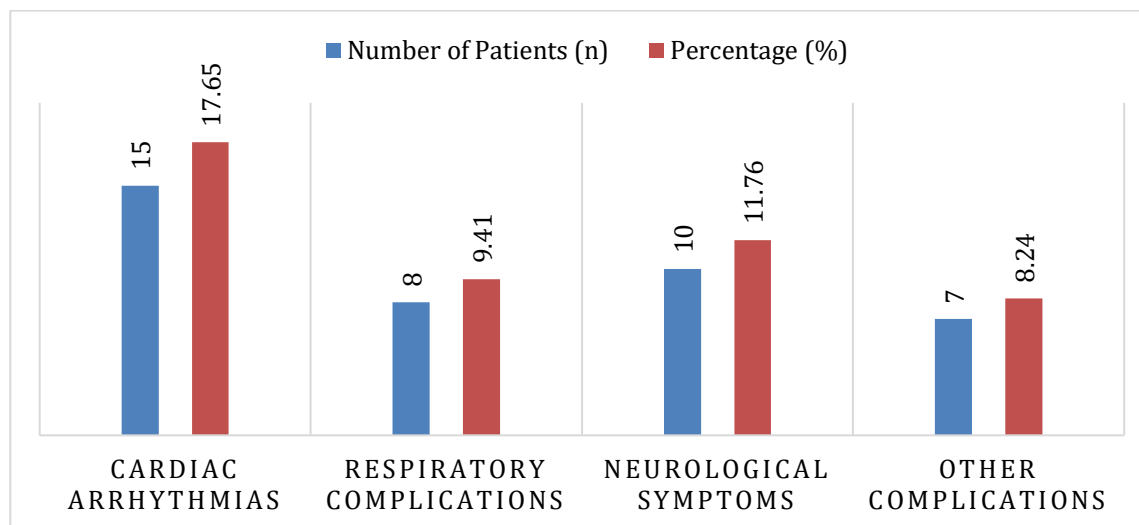
The results of a logistic regression analysis examining factors associated with hypomagnesemia in individuals with AECOPD are shown in Table 5. Interestingly, age turns out to be a major predictor, with those 55 years of age or older showing significantly greater chances of hypomagnesemia than younger people (OR = 2.5, 95% CI: 1.8 - 3.4, p < 0.001). On the other hand, as shown by their respective p-values of 0.087 and 0.302, gender and smoking history do not substantially affect the risk of hypomagnesemia. On the other hand, the degree of the exacerbation shows significance: patients with severe exacerbations were more likely to have hypomagnesemia than patients with mild exacerbations (OR = 1.7, 95% CI: 1.1 - 2.5, p = 0.014).

**Table 5: Analyzing Logistic Regression to Find Hypomagnesemia Predictors**

Predictor	OR (95% CI)	p-value
Age (≥55 vs. <55)	2.5 (1.8 - 3.4)	<0.001
Gender (Female vs. Male)	0.9 (0.6 - 1.3)	0.302
Smoking History (Non-Smokers vs. Smokers)	1.2 (0.8 - 1.7)	0.087
Exacerbation Severity (Severe vs. Moderate)	1.7 (1.1 - 2.5)	0.014

**Figure 2** presents a summary of the adverse events linked to hypomagnesemia in individuals with AECOPD. Cardiac arrhythmias account for the majority of documented adverse events, impacting

15 individuals (17.65%), with neurological symptoms following in 10 patients (11.76%). Furthermore, eight patients (9.41%) report respiratory difficulties, and seven patients (8.24%) report additional issues.



**Figure 2:** Adverse Events Related to Hypomagnesemia

## Discussion

The results of this investigation show that hypomagnesemia is much more common in individuals with AECOPD, accounting for 21.25% of the cohort under investigation. Although under steady settings, this incidence is consistent with other study showing a significant prevalence of hypomagnesemia in COPD patients [13]. Of the 400 patients with AECOPD in our research, 85 were found to have hypomagnesemia. These findings highlight how crucial it is to treat AECOPD while taking electrolyte abnormalities—especially those related to magnesium levels—into account. Comparing it to previous research highlights new insights and also shows continuity in certain areas. For example, our results confirm the reported correlation between hypomagnesemia and older age: 46 patients 55 years or older had hypomagnesemia compared to 39 patients under 55 years ( $p < 0.001$ ) [14]. Older people are more susceptible to electrolyte imbalances due to age-related changes in magnesium metabolism, renal function, and food consumption [15]. This consistency highlights the strength of our results and demonstrates the practical significance of age in predicting hypomagnesemia in AECOPD.

Furthermore, our research clarifies the connection between the degree of an exacerbation and magnesium status, demonstrating a substantial correlation between severe exacerbations and reduced blood magnesium levels. Thirty-three patients in the group with moderate exacerbation severity and fifty-two patients in the group with severe exacerbation ( $p = 0.014$ ) had hypomagnesemia [16, 17]. Interestingly, the severe exacerbation group's mean blood magnesium level (1.4 mg/dL) is noticeably lower than the group's moderate exacerbation level (1.8 mg/dL). This discovery emphasizes the significance of tracking electrolyte dynamics in AECOPD by providing quantitative proof of the effect of exacerbation severity on magnesium levels.

The negative consequences linked to hypomagnesemia that we found in our research highlight the clinical importance of magnesium dysregulation in AECOPD. Out of all the complications, cardiac arrhythmias are the most common, involving 15 individuals (17.65%). Similarly, eight patients (9.41%) and ten patients (11.76%) have experienced respiratory issues and neurological complaints, respectively [18–20]. The discovery of these adverse events highlights the need of proactive magnesium level monitoring and treatment in patients with AECOPD in order to reduce possible consequences and enhance clinical outcomes.

## Conclusion

This research showed that hypomagnesemia is rather common in individuals with AECOPD, with 21.25% of the sample displaying this electrolyte imbalance. The results underscore the practical importance of monitoring magnesium levels in the treatment of AECOPD, especially in elderly patients and those experiencing severe exacerbations. The occurrence of adverse events linked to hypomagnesemia, such as respiratory difficulties, cardiac arrhythmias, and neurological symptoms, highlights the need of early management to enhance therapeutic results in this susceptible group. These findings highlight magnesium supplementation's potential as a therapeutic adjunct in the treatment of AECOPD, a position that merits further research and thought in clinical practice.

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