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# EVALUATION OF SERUM MAGNESIUM LEVELS AMONG ASTHMATIC CHILDREN IN THE AGE GROUP OF 5–12 YEARS IN A TERTIARY CARE CENTRE.

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## Abstract

***Background:*** Asthma is one of the most common chronic respiratory disorders affecting children and is characterized by airway inflammation, bronchial hyperresponsiveness, and recurrent episodes of wheezing and breathlessness. Magnesium plays an important role in smooth muscle relaxation, bronchodilation, and regulation of inflammatory responses. Reduced serum magnesium levels have been associated with increased bronchial reactivity and poor asthma control. ***Aims:*** To evaluate serum magnesium levels among asthmatic children aged 5–12 years and assess its association with severity and control of asthma. ***Materials and Methods:*** This prospective observational study was conducted over a period of 10 months in the Department of Paediatrics at Sree Mookambika Institute of Medical Sciences. A total of 60 children aged between 5 and 12 years diagnosed with bronchial asthma were included in the study. Diagnosis of asthma was made based on clinical history, examination findings, and standard pediatric asthma guidelines. Detailed demographic data, asthma history, frequency of exacerbations, medication usage, hospitalization history, and family history of atopy were recorded. Clinical evaluation included assessment of respiratory rate, oxygen saturation, wheezing, and severity of asthma symptoms. Serum magnesium levels were measured in all participants using standard laboratory methods. Statistical analysis was performed using chi-square test and independent t-test, with $p < 0.05$ considered statistically significant. ***Results:*** Among the 60 asthmatic children included in the study moderate persistent asthma was the most common severity category observed in 24 (40.0%) children, followed by mild persistent asthma in 18 (30.0%) cases. Mean serum magnesium level among study participants was 1.71 ± 0.29 mg/dL. Hypomagnesemia was observed in 21 (35.0%) children and was significantly more common among patients with moderate to severe persistent asthma ($p < 0.01$). Children with frequent exacerbations and recurrent hospital admissions demonstrated lower serum magnesium levels compared to those with intermittent or well-controlled asthma. Significant association was also observed between hypomagnesemia and increased use of bronchodilator therapy ($p = 0.02$). ***Conclusion:*** Reduced serum magnesium levels were commonly observed among children with persistent and poorly controlled asthma. Assessment of serum magnesium levels may serve as a useful adjunct in evaluating asthma control and disease severity.

**Keywords:** Asthma; Bronchial hyper-responsiveness; Children; Hypomagnesemia; Pediatric asthma; Serum magnesium.



## INTRODUCTION

Asthma is one of the most common chronic respiratory diseases affecting children worldwide and represents a major cause of morbidity, recurrent hospital visits, school absenteeism, and impaired quality of life.1 It is characterized by chronic airway inflammation, bronchial hyperresponsiveness, reversible airflow obstruction, and recurrent episodes of wheezing, cough, breathlessness, and chest tightness.2 Childhood asthma has shown a rising prevalence over recent decades, particularly in urban populations, due to increasing environmental pollution, allergen exposure, changing lifestyle patterns, and genetic predisposition.3

The pathophysiology of asthma involves airway inflammation, mucosal edema, increased mucus secretion, and bronchial smooth muscle constriction. Various inflammatory mediators including histamine, leukotrienes, cytokines, and eosinophils contribute to airway narrowing and hyperreactivity.4 Asthmatic children may experience intermittent or persistent symptoms ranging from mild episodic wheezing to severe acute exacerbations requiring hospitalization. Frequent attacks negatively affect physical activity, sleep quality, growth, academic performance, and psychological well-being.5

Magnesium is an essential intracellular cation involved in numerous physiological processes including neuromuscular conduction, smooth muscle relaxation, enzymatic reactions, and regulation of inflammatory responses.6 In the respiratory system, magnesium plays an important role in bronchial smooth muscle relaxation by antagonizing calcium-mediated muscle contraction and inhibiting acetylcholine release at neuromuscular junctions.7 It also stabilizes mast cells and reduces release of inflammatory mediators, thereby contributing to bronchodilation and improved airway function.8

Several studies have suggested that magnesium deficiency may contribute to increased bronchial hyperresponsiveness and poor asthma control. Reduced serum magnesium levels have been associated with recurrent wheezing, severe asthma attacks, and increased requirement for bronchodilator therapy.9 Hypomagnesemia may result from inadequate dietary intake, chronic inflammation, increased urinary excretion, prolonged use of beta-agonists, corticosteroid therapy, or poor nutritional status. Persistent magnesium deficiency may worsen airway inflammation and increase susceptibility to recurrent exacerbations.10

Assessment of serum magnesium levels in asthmatic children has gained importance because of its potential role in disease severity and therapeutic response. Lower magnesium levels have been observed in children with poorly controlled asthma and frequent hospital admissions. Intravenous magnesium sulfate is currently used as an adjunct therapy in severe acute asthma because of its bronchodilatory and anti-inflammatory effects.11 This further supports the physiological importance of magnesium in airway function and asthma management.

Despite increasing awareness regarding asthma management, limited attention has been given to micronutrient deficiencies and their relationship with asthma severity in pediatric populations. Evaluation of serum magnesium levels may help identify children at risk of recurrent exacerbations and poor disease control. Early correction of magnesium deficiency may potentially improve therapeutic response and reduce frequency of hospital visits.

**AIMS AND OBJECTIVES**

- To evaluate serum magnesium levels among asthmatic children aged 5–12 years and assess its association with severity and control of asthma.

## MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Paediatrics at Sree Mookambika Institute of Medical Sciences over a period of 10 months from June 2025 to March 2026. The study included 60 children aged between 5 and 12 years who were diagnosed with bronchial asthma and attended the pediatric outpatient department or were admitted for asthma exacerbation during the study period. Written informed consent was obtained from parents or guardians of all participating children.

Children aged 5–12 years with a confirmed diagnosis of bronchial asthma based on clinical history, recurrent episodes of wheezing, breathlessness, cough, chest tightness, and response to bronchodilator therapy according to standard pediatric asthma guidelines were included in the study. Both newly diagnosed and previously diagnosed asthmatic children receiving treatment were enrolled.

Children with chronic renal disease, congenital heart disease, chronic liver disease, severe malnutrition, endocrine disorders, neuromuscular disorders, chronic gastrointestinal disease causing malabsorption, and acute severe systemic infections were excluded from the study. Patients receiving magnesium supplementation, diuretic therapy, or medications known to alter serum magnesium levels were also excluded. Children with other chronic respiratory illnesses such as cystic fibrosis, bronchiectasis, pulmonary tuberculosis, or congenital airway anomalies were not included in the study.

Detailed demographic information including age, gender, socioeconomic status, family history of asthma or atopy, exposure to passive smoking, environmental allergens, duration of asthma, frequency of exacerbations, hospitalization history, and medication usage was recorded using a structured proforma. A detailed clinical examination was performed in all patients, including assessment of respiratory rate, pulse rate, oxygen saturation, wheezing, use of accessory respiratory muscles, and severity of respiratory distress. Nutritional assessment and anthropometric measurements were also documented.

Asthma severity was classified as intermittent, mild persistent, moderate persistent, and severe persistent based on symptom frequency, nighttime symptoms, use of rescue medications, and activity limitation.

Laboratory investigations included complete blood count, eosinophil count, serum magnesium estimation, and other routine investigations as clinically indicated. Serum magnesium levels were measured using standard automated biochemical

methods under aseptic precautions. Serum magnesium values below the normal reference range were considered hypomagnesemia. Additional investigations including chest radiograph and pulmonary function testing were performed in selected children whenever required.

All collected data were entered into a master chart and analyzed using appropriate statistical methods. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. Statistical analysis was performed using chi-square test and independent t-test wherever applicable. A p-value less than 0.05 was considered statistically significant.

## RESULTS

The majority of asthmatic children belonged to the 8–12 years age group, accounting for 35 (58.3%) cases. Male predominance was observed with 38 (63.3%) patients, showing a statistically significant higher prevalence of asthma among boys.

**Table 1: Age and Gender Distribution of Study Population**

| Variable | Category | Number (n) | Percentage (%) | p-value |
|---|---|---|---|---|
| Age Group | 5–7 years | 25 | 41.7 | 0.19 |
| | 8–12 years | 35 | 58.3 | |
| Gender | Male | 38 | 63.3 | 0.03* |
| | Female | 22 | 36.7 | |

Wheezing was the most common presenting symptom, followed by cough and breathlessness. A considerable proportion of children had positive family history of asthma or exposure to passive smoking, suggesting the contribution of genetic and environmental risk factors. (Table 2)

**Table 2: Clinical Profile of Asthmatic Children**

| Clinical Feature | Number (n) | Percentage (%) |
|---|---|---|
| Wheezing | 56 | 93.3 |
| Cough | 49 | 81.7 |
| Breathlessness | 44 | 73.3 |
| Nocturnal symptoms | 32 | 53.3 |
| Chest tightness | 21 | 35.0 |
| Family history of asthma/atopy | 27 | 45.0 |
| Passive smoking exposure | 19 | 31.7 |

Moderate persistent asthma was the most common severity category observed in 24 (40.0%) children. Severe persistent asthma was identified in 7 (11.7%) patients, indicating substantial disease burden in a subset of children. (Table 3)

**Table 3: Severity Classification of Asthma**

| Severity of Asthma | Number (n) | Percentage (%) |
|---|---|---|
| Intermittent asthma | 11 | 18.3 |
| Mild persistent asthma | 18 | 30.0 |
| Moderate persistent asthma | 24 | 40.0 |
| Severe persistent asthma | 7 | 11.7 |

Hypomagnesemia was observed in 21 (35.0%) asthmatic children and showed significant association with asthma severity. Reduced serum magnesium levels were more commonly identified among children with persistent asthma. (Table 4)

**Table 4: Serum Magnesium Levels Among Study Population**

| Serum Magnesium Status | Number (n) | Percentage (%) | p-value |
|---|---|---|---|
| Normal magnesium levels | 39 | 65.0 | 0.01* |
| Hypomagnesemia | 21 | 35.0 | |

The mean serum magnesium level among study participants was slightly lower than normal reference values in a considerable proportion of patients. Elevated eosinophil counts reflected underlying allergic airway inflammation commonly associated with bronchial asthma. (Table 5)

**Table 5: Mean Hematological and Biochemical Parameters**

| Parameter | Mean ± SD |
|---|---|
| Serum magnesium (mg/dL) | 1.71 ± 0.29 |
| Eosinophil count (%) | 6.8 ± 2.1 |
| Oxygen saturation (%) | 94.2 ± 2.8 |
| Duration of asthma (years) | 3.4 ± 1.9 |

Hypomagnesemia showed significant association with increasing asthma severity. Children with moderate and severe persistent asthma demonstrated markedly lower serum magnesium levels compared to those with intermittent asthma. (Table 6).

**Table 6: Correlation of Serum Magnesium Levels with Asthma Severity**

| Asthma Severity | Hypomagnesemia n (%) | Normal Magnesium n (%) | p-value |
|---|---|---|---|
| Intermittent asthma | 1 (9.1%) | 10 (90.9%) | <0.01* |
| Mild persistent asthma | 4 (22.2%) | 14 (77.8%) | |
| Moderate persistent asthma | 11 (45.8%) | 13 (54.2%) | |
| Severe persistent asthma | 5 (71.4%) | 2 (28.6%) | |

Hypomagnesemia was significantly associated with frequent asthma exacerbations, recurrent hospital admissions, and increased bronchodilator usage. Children with reduced serum magnesium levels demonstrated poorer asthma control and greater disease severity. (Table 7).

**Table 7: Correlation of Hypomagnesemia with Clinical Variables**

| Variable | Category | Hypomagnesemia n (%) | Normal Magnesium n (%) | p-value |
|---|---|---|---|---|
| Frequent exacerbations (>3/year) | Present | 15 (62.5%) | 9 (37.5%) | <0.01* |
| | Absent | 6 (16.7%) | 30 (83.3%) | |
| Hospital admissions | Present | 13 (59.1%) | 9 (40.9%) | 0.01* |
| | Absent | 8 (21.1%) | 30 (78.9%) | |
| Frequent bronchodilator use | Present | 14 (58.3%) | 10 (41.7%) | 0.02* |
| | Absent | 7 (19.4%) | 29 (80.6%) | |

## DISCUSSION

A total of 60 children aged 5–12 years diagnosed with bronchial asthma were included in the present study. Most patients belonged to the 8–12 years age group, accounting for 35 (58.3%) cases. Male predominance was observed with 38 (63.3%) children, indicating higher prevalence of asthma among boys in the pediatric age group. Similar male predominance was reported by Mezori AA et al.12 who observed that males constituted the majority of asthmatic children in both study and control groups. Most children in the present study had recurrent wheezing episodes and variable respiratory symptoms suggestive of persistent airway inflammation and bronchial hyperresponsiveness.

Wheezing was the most common presenting symptom, observed in 56 (93.3%) children, followed by cough in 49 (81.7%) and breathlessness in 44 (73.3%) patients. Nocturnal symptoms were present in 32 (53.3%) children, reflecting poor asthma control and increased nighttime airway hyperreactivity. A positive family history of asthma or atopy was identified in 27 (45.0%) cases, suggesting an important genetic predisposition. Exposure to passive smoking was observed in 19 (31.7%) children and may have contributed to recurrent exacerbations and worsening respiratory symptoms. Similar findings of persistent symptoms and poor asthma control were described by Daliparty VM et al.13 who demonstrated worsening asthma control among children with lower serum magnesium levels.

Moderate persistent asthma was the predominant severity category in the present study, affecting 24 (40.0%) children, followed by mild persistent asthma in 18 (30.0%) patients. Severe persistent asthma was identified in 7 (11.7%) children, indicating considerable disease burden in a subset of patients requiring frequent bronchodilator therapy and recurrent hospital visits. Increased asthma severity was associated with frequent exacerbations, prolonged symptom duration, and greater healthcare utilization. Comparable observations were made by Gaber E et al.14 who reported significantly lower serum magnesium levels among children with severe persistent asthma compared to those with milder forms of disease. Saidoka KM et al.15 also demonstrated an inverse relationship between serum magnesium levels and asthma severity.

The mean serum magnesium level among study participants was 1.71 ± 0.29 mg/dL. Hypomagnesemia was observed in 21 (35.0%) children and showed significant association with asthma severity. Children with moderate and severe persistent asthma demonstrated lower serum magnesium levels compared to those with intermittent asthma. Hypomagnesemia was present in 5 (71.4%) children with severe persistent asthma, indicating a possible relationship between magnesium deficiency and worsening airway hyperreactivity.

Similar findings were reported by Hasan MA et al.16 who observed significantly higher prevalence of hypomagnesemia among asthmatic children compared to controls and demonstrated increased bronchodilator requirement among children with low magnesium levels. Mezori AA et al.12 and Saidoka KM et al.15 also reported significantly reduced serum magnesium levels in asthmatic children and progressive reduction in magnesium concentration with increasing asthma severity.

Frequent asthma exacerbations occurring more than three times per year were significantly associated with reduced serum magnesium levels in the present study. Among children with frequent exacerbations, 15 (62.5%) demonstrated hypomagnesemia. Similarly, recurrent hospital admissions and increased bronchodilator use were more common among children with low serum magnesium levels. These findings suggest that magnesium deficiency may contribute to poor asthma control, recurrent symptoms, and increased medication requirement.

Comparable results were documented by Ahsan R et al.17 who reported that children with hypomagnesemia had higher frequency of prolonged hospital stay and severe asthma attacks. Daliparty VM et al.13 similarly observed progressive decline in serum magnesium levels as asthma control worsened from well-controlled to uncontrolled disease.

Elevated eosinophil counts observed among many children in the present study reflected underlying allergic airway inflammation commonly associated with bronchial asthma. Persistent inflammation along with repeated beta-agonist use may contribute to alterations in magnesium balance. Gaber E et al.14 further demonstrated significant positive correlation between serum magnesium levels and pulmonary function parameters suggesting an important physiological role of magnesium in airway function and bronchial smooth muscle relaxation.

However, not all studies demonstrated significant correlation between serum magnesium levels and asthma severity. Chitamanni P et al.18 reported relatively low prevalence of hypomagnesemia among children with mild persistent asthma and found no significant association between serum magnesium levels, asthma control test scores, or pulmonary function tests. These differences may be related to variations in study population, asthma severity distribution, nutritional status, and treatment practices.

## CONCLUSION

Reduced serum magnesium levels were commonly observed among children with persistent and poorly controlled bronchial asthma. Hypomagnesemia showed significant association with increased asthma severity, frequent exacerbations, recurrent hospital admissions, and higher bronchodilator usage. Moderate persistent asthma was the most common clinical presentation, with wheezing and cough being the predominant symptoms. Assessment of serum magnesium levels may serve as a useful adjunct in evaluating disease severity and asthma control in pediatric patients. Early recognition and correction of magnesium deficiency may contribute to improved clinical outcomes, reduced morbidity, and better long-term management of bronchial asthma among children.

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**CONFLICTS OF INTEREST**

There are no conflicts of interest.

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