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A Study on The Levels of Serum Vitamin D and Magnesium in Asthma Severity

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ABSTRACT

Serum magnesium levels influence the concentration of circulating vitamin D in blood, which in turn influence immunity; thus, it plays an important role in the asthma pathogenesis. Adult asthma is less studied, hypomagnesemia along with the vitamin D deficiency and insufficiency, is common in asthmatic patients, causing frequent attacks of asthma, infections of respiratory tract, severe exacerbations, and poor bronchodilator response. **AIMS AND OBJECTIVES:** To measure vitamin D insufficiency and deficiency levels, as well as levels of serum magnesium in asthmatic patients, and correlate them with asthma severity. **MATERIAL AND METHODS:** This is a cross-sectional case-control study with 60 chronic stable asthma patients and 60 healthy controls. A pulmonary function test was performed following the clinical history and systemic examination. All subjects had their serum levels of magnesium, 25-hydroxycholecalciferol [25(OH)D] measured. **RESULTS:** A significant relationship was observed between vitamin D deficiency, hypomagnesemia, and asthma severity. **CONCLUSION:** Vitamin D and serum magnesium deficiency are frequent in asthma patients. Lower levels of one or both are associated with increased asthma severity, frequency of attacks, and exacerbation. Serum 25(OH)D and magnesium levels may be useful indicators of asthma severity.

Keywords: Asthma, Hypomagnesemia, 25 Hydroxycholecalciferol

I. INTRODUCTION

Asthma is a heterogenous disorder usually characterized by chronic airway inflammation. It is identified by a history of respiratory symptoms, including wheezing, shortness of breath, tightness in the chest, and cough, that change over time and in severity, as well as fluctuating expiratory airflow

restriction and reversible with bronchodilator. In many nations, it affects 1–18% of the population.(1) Due to its potential to shield against respiratory infections, vitamin D deficiency is a serious public health issue.Vitamin D's major function is to regulate the homeostasis of calcium and phosphorus, and the factors that respond to plasma levels of calcium, phosphate, and magnesium regulate vitamin D metabolism. The active form of vitamin D, calcitriol, has an impact on several processes, including insulin secretion, interleukin generation by T-lymphocytes and immunoglobulin synthesis by B-lymphocytes suppression, monocyte precursor cell differentiation, and cell proliferation regulation. Vitamin D receptors are expressed on immune system cells such T lymphocytes, activated B lymphocytes, and dendritic cells (VDRs) [2]. In addition, the presence of 1, -hydroxylase in dendritic cells suggests that 25-hydroxycholecalciferol (Calcidiol) can be converted locally to its active form (Calcitriol), where it can subsequently support an immune response. Due to its insufficiency and triggering circumstances, asthma, allergies, and illness aggravation may be more prevalent [3].

According to a few prior studies, a lack of magnesium (Mg) is linked to ventricular arrhythmia, pulmonary vascular drag, and enhanced tracheobronchial hyperreactivity [4,5]. Magnesium relaxes the smooth muscles of the bronchi and widens the airways, most likely through changing the calcium ion's mobility. On the other hand, hypomagnesemia may cause bronchoconstriction. In some people, it may seriously impair neuromuscular function, which could result in bronchial spasms [6]. Magnesium (Mg) plays a crucial part in the synthesis and metabolism of vitamin D and is the second-most prevalent intracellular cation. It is also a crucial component in bone mineralization. Hypovitaminosis D is linked to low levels of blood magnesium.[7, 8]. Hypomagnesemia can exacerbate the clinical condition of asthma by inducing tracheobronchial hyperreactivity as a result of lower vitamin D levels and an increased risk of respiratory infections. [4, 6, 7]

So, the purpose of this study was to identify the prevalence of hypomagnesemia in asthma patients who also had vitamin D deficiency and insufficiency. This study's goal is to ascertain the relationship between serum Mg and vitamin D levels and asthma severity.

II. MATERIALS AND METHODS

A cross-sectional case-control study that was conducted from July 2021 to December 2022 is discussed below. Study participants comprised 60 people with chronic stable asthma treated at the Great Eastern Medical School and Hospital's outpatient respiratory department in Srikakulam, Andhra Pradesh, and 60 healthy people (controls) matched for age, sex, and ethnic origin with the cases. Written informed consent was obtained from each patient.

INCLUSION CRITERIA:

a) Stable asthma (characterized as not having experienced an exacerbation within last week or at the time of presentation).

b) Age more than 12 years.

c) Non smoker

EXCLUSION CRITERIA:

a) Medical conditions such as chronic renal disease, type 2 diabetes, alcoholism, and diarrhoea.

b) Those receiving diuretic therapy.

c) Pregnancy.

d) Intermittent asthma.

e) Cardiac disease.

Clinical history, including drug history, were taken for all the study participants. They underwent a comprehensive systematic analysis. Blood samples were collected in plain vacutainers (with clot activator) under aseptic circumstances in order to measure the serum concentrations of magnesium and vitamin D (25(OH) D). In order to determine the

severity (or stage) of each patient's asthma, they underwent a pulmonary function test (PFT) utilising spirometry to evaluate their forced expiratory volume (FEV1), FVC, and PEF.

Chemiluminescent Immunoassay (CLIA) was used on a Beckman Coulter Access-2 instrument to measure the levels of serum 25(OH)D.

Normal levels are 30–60 ng/mL

Deficiency <20 ng/mL (50 mmol)

Insufficiency <30 ng/mL (75 mmol)

ERBA-EM200 fully automated analyser and ERBA reagents were used to spectrophotometrically measure serum magnesium levels. Magnesium concentration in serum: 1.7–2.5 mg/dL

Statistical Methods:

Following methods were used in statistical analyses:

(1) We employed descriptive statistics; for continuous data, range, mean (x), and standard deviation (sd) were calculated; for categorical variables, proportion and percentage were computed.

(2) The 2-sample Z-test was used to compare two sample proportions, and P values were obtained.

(3) The ANOVA test was used to compare variables in three or more groups.

III.RESULTS

There were 60 cases in Group I (asthmatic patients), with 22 (36.7%) females and 38 (63.3%) males. With ages ranging from 19 to 71, their median age was 40 ± 13 years. Of the 60 healthy patients in Group II (controls), 45 (75%) were males and 15 (25%) were females. Among the ages of 18 and 70, with a mean age of 42 ± 11 years.

The demographics of both groups are shown in Table 1. The asthmatic patients (group I) were divided into three groups: mild persistent asthma (14.3%), moderate persistent asthma (27.5%), and severe persistent asthma (31.7%). According to GINA guidelines 2022, the disease's severity was classified [1].

Table 1: Distribution of patients and control groups.

	Group 1 cases (n=60)	Group 2 Controls (n=60)
Gender		
Male	22 (36.7%)	
Severity of asthma		
Mild	4 (18.2%)	30 (75%)
Moderate	10 (45.5%)	
Severe	8 (36.4%)	
Females	38(63.3%)	
Severity of asthma		
Mild	10 (26.3%)	10 (25%)
Moderate	17 (44.7%)	
Severe	11 (28.9%)	
Age	40 ± 13	41 ± 10

TABLe 2: Serum 25(OH)D and magnesium levels in patients and controls

		Cases	Controls	Z value	P value
Serum 25(OH) D	Deficient (<50 nmol/L)	38 (63.3%)	0 (0%)	6.4	<0.001
	Insufficient (<75 nmol/L)	60 (100%)	30 (50%)	6.1	
Magnesium	Normal	25 (41.2%)	57 (95%)	5.5	<0.001
	Hypomagnesemia (<1.7 mg/dl)	35 (58.8%)	3 (5%)	5.5	

While 100% of asthmatic patients had insufficiency (<75 nmol/L), 63.3% of them had a vitamin D deficiency (<50 nmol/L). When it came to their serum magnesium levels, 58.8% of asthmatic individuals exhibited hypomagnesemia (<1.7 mg/dL).

TABLe 3 : Comparison of serum level of 25(OH)D, magnesium in different grades of asthma.

	S. magnesium levels (mean ± sd) mg/dL	Sr. 25 (OH) D (mean ± sd) nmol/L
Cases		
Mild	1.86 ± 0.07	57 ± 9.7
Moderate	1.70 ± 0.07	47.7 ± 6.2
Severe	1.53 ± 0.09	31 ± 5.2
Controls	1.92 ± 0.1	86 ± 13.3
One-way ANOVA P value	<0.001	<0.001

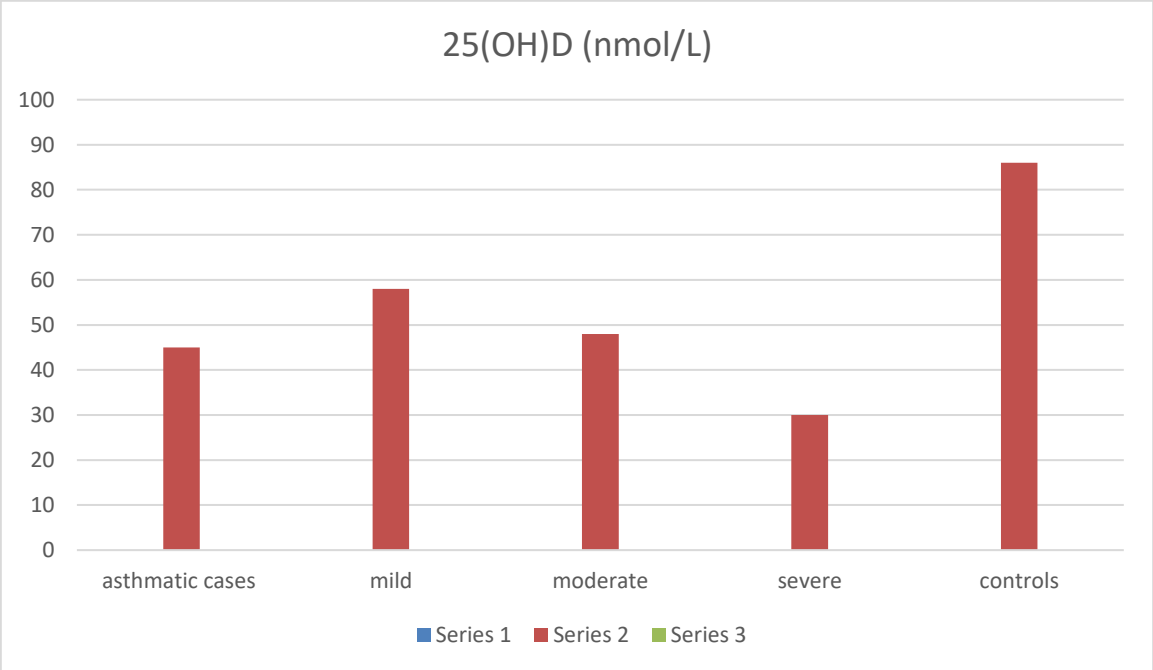

Figure 1 : Vitamin D_3 levels in different grades of asthma.

As their levels are highest in mild form of asthma and lowest in severe persistent asthma (P <0.001), Table 3 and Figure 1 demonstrate that serum levels of magnesium and 25(OH)D decline with the severity of the disease. serum levels of magnesium and vitamin D were negatively correlated with asthma severity scores.

TABLe 5: Prevalence of hypomagnesemia and hypovitaminosis D in the different grades of asthma severity

Grades of asthma	Hypomagnesemia (<1.7 mg/dL)	Hypovitaminosis D Deficiency	insufficiency	Hypomagnesemia + vitamin D deficiency
Mild	5 (14.3%)	3 (21.4%)	14(100%)	1 (7.1%)
Moderate	13 (48.1%)	16 (59.2%)	27(100%)	10 (37%)
Severe	13 (68.4%)	19 (100%)	19(100%)	13 (68.4%)
Total	31 (51.7%)	38 (63.3%)	60(100%)	24 (40%)

As shown in Table 5, prevalence of hypomagnesemia and vitamin D deficiency increase with the increase in disease severity.

IV. DISCUSSION

According to our study, vitamin D deficiency is defined as blood 25(OH)D levels below 50 nmol/L (20 ng/mL) and insufficiency as levels above 75 nmol/L (30 ng/mL) [9,10]. This study found that, compared to controls, who had 50% insufficiency and 0% deficiency, patients had 100% insufficiency and had a vitamin D deficiency of 63.3%. Asthma patients in group I had a mean level of 25(OH)D that was considerably lower (44.912 nmol/L) than controls in group II (8613.3 nmol/L). The vitamin D status of asthmatic patients has been the subject of several investigations.

Vitamin D is a powerful predictor of asthma, according to research by Bener et al. [3] on the incidence of hypomagnesemia and vitamin D deficiency in asthmatic children.

Columbo et al. [11] showed that 79% of the elderly asthmatic participants had baseline serum vitamin D levels that were below normal. These findings illustrate that vitamin D deficiency and insufficiency are quite prevalent in older asthmatic and respiratory diseases.

Another study by Sibes Kumar Das et al. [12] showed that between hypomagnesemia and tachycardia, there was no statistically significant correlation, use of short-acting 2 -agonist, or montelukast, but there was an association with tachypnoea, severe asthma, use of long-acting 2 -agonist, inhaled corticosteroids, theophylline, use of 3 medications, and previous and future exacerbations.

In their investigation, Brehm et al. [13] discovered a similar association. They discovered a higher frequency of allergic rhinitis in people with vitamin D deficiency. Why widespread vitamin D insufficiency affects different populations is unknown. High socioeconomic status, however, may lead to vitamin D insufficiency, which increases the incidence of allergic disorders such bronchial asthma. These factors also include a western lifestyle that emphasises indoor activities and little exposure to sunlight. In the current investigation, patients' serum magnesium levels were lower than those of the controls. This could be explained by hypomagnesemia caused by a vitamin D deficiency as a result of a regular usage of 2-agonist inhalation or nebulization [14, 15] [16].

According to the current study, hypomagnesemia, vitamin D deficiency, and asthma severity are all related. The serum 25(OH)D levels in asthmatic patients were mild persistent: 579.7 nmol/L, moderate persistent: 47.7 6.2 nmol/L, and severe persistent: 315.2 nmol/L. This was in agreement

with Brehm et al. [13] and Sandhu and Casale [17], who reported that hypovitaminosis D aggravate the risk of severe exacerbations of asthma in children.

According to our study, hypomagnesemia is prevalent in those with mild persistent asthma (1.86±0.07 mg/dL; 23.3%), moderate persistent asthma (1.70±0.07 mg/dL; 45%), and severe persistent asthma (1.53±0.09 mg/dL; 31.7%). According to the results, serum levels of 25(OH)D and magnesium decrease as disease severity increases. Their concentrations are highest in cases of mild asthma and lowest in cases of severe persistent asthma.

V. CONCLUSION

1) Asthmatic patients frequently have vitamin D deficiencies.
2) Moreover, lower magnesium and vitamin D levels are linked to more severe asthma, ineffective asthma control, and frequent exacerbations in asthmatic patients.
3) Magnesium levels and serum 25(OH)D may be used as indicators of the severity of asthma. As a result, these analytical levels in asthmatic patients should be investigated and modified as appropriate.

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