Section: Biochemistry

Original Research Article

ASSOCIATION OF VITAMIN- D DEFICIENCY WITH ASTHMA SEVERITY

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ABSTRACT

Background: Vitamin D deficiency has become increasingly prevalent due to modern lifestyle changes, reduced sun exposure, and altered dietary habits. Beyond its well-established role in calcium metabolism and bone health, vitamin D has been implicated in immune regulation and respiratory health. Bronchial asthma, a chronic inflammatory airway disease characterized by airway hyperresponsiveness and reversible airflow obstruction, has been hypothesized to have a potential association with vitamin D levels. **Objective:** Given the immunomodulatory role of vitamin D, this study aimed to evaluate and compare serum 25-hydroxy vitamin D [25(OH)D] levels in individuals diagnosed with bronchial asthma and a healthy control group to explore potential associations between vitamin D status and pulmonary function.

Materials and Methods: This case-control study included a total of 100 participants, comprising 50 patients with bronchial asthma and 50 healthy control subjects. Serum 25(OH)D levels were measured in both groups to determine vitamin D status. Additionally, a trained respiratory specialist assessed airway reversibility, peak flowmetry, and spirometry in all participants to evaluate pulmonary function. The primary outcome measures included: Forced expiratory volume in the first second (FEV1), Peak expiratory flow rate (PEFR) & Airway reversibility testing. The collected data were statistically analyzed using t-tests, one-way analysis of variance (ANOVA), and chi-square tests in Stata software (version 11) to determine the significance of differences and correlations.

Results: The mean age (±SD) of participants in the asthma group and control group was 49.12 ± 16.12 years and 46.3 ± 16.80 years, respectively (P=0.388), indicating no significant difference in age distribution. Prevalence of vitamin D deficiency was notably high in both groups, affecting 70% of asthmatic patients and 64% of healthy controls, suggesting a widespread deficiency irrespective of disease status. The mean (±SD) serum 25(OH)D levels were 17.2 ± 15.1 ng/mL in the asthma group and 17.0 ± 16.4 ng/mL in the control group (P=0.660), indicating no statistically significant difference in vitamin D levels between the two groups. A positive correlation (r=0.3) was observed between vitamin D levels and FEV1, suggesting that individuals with higher serum 25(OH)D levels may have better lung function. However, this correlation was modest and warrants further investigation.

Conclusion: Our findings indicate that there was no significant difference in serum vitamin D levels between patients with bronchial asthma and healthy controls. Despite no significant difference between groups, the widespread vitamin D deficiency (≥ 70%) highlights an urgent need for public health intervention. Additionally, the positive correlation between vitamin D levels

and pulmonary function (FEV1) suggests that vitamin D may play a role in maintaining lung function. While this study does not establish a causal relationship between vitamin D deficiency and asthma severity, it supports the growing interest in vitamin D as a potential modifiable factor in respiratory health. Future clinical trials should evaluate vitamin D supplementation as a potential adjunct therapy for asthma management.
Keywords: Asthma, Bronchial Asthma, Vitamin D Deficiency, Pulmonary Function, Spirometry, Airway Obstruction, 25-Hydroxy Vitamin D, Respiratory Health.

INTRODUCTION

Asthma is a major global health concern, affecting millions of individuals across all age groups and imposing a significant socioeconomic burden on healthcare systems. Characterized by chronic airway inflammation, bronchial hyperresponsiveness, and reversible airflow obstruction, asthma manifests through diverse clinical presentations and varies in severity from intermittent to persistent and uncontrolled forms. Despite advances in pharmacological treatments, a substantial proportion of asthma patients continue to experience poor symptom control, frequent exacerbations, and progressive decline in lung function.[1,2]

Emerging research has highlighted the potential role of vitamin D in asthma pathogenesis and severity. Traditionally recognized for its role in bone metabolism and calcium homeostasis, vitamin D has also been identified as a key immunomodulatory agent that influences innate and adaptive immune responses. Recent studies have shown that vitamin D deficiency is associated with increased airway inflammation, impaired lung function, poor asthma control, and heightened risk of exacerbations. Cross-sectional and cohort studies have reported that patients with severe and uncontrolled asthma exhibit significantly lower serum levels of vitamin D, and some findings suggest that vitamin D supplementation may enhance corticosteroid responsiveness and reduce inflammation in asthma patients.[3,4,5]

Vitamin D is obtained from two primary sources: cutaneous synthesis from ultraviolet B (UVB) radiation exposure and dietary intake. The two major forms of vitamin D—vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol)—undergo hepatic and renal hydroxylation to produce 25-hydroxyvitamin D (25[OH]D), the most widely measured biomarker of vitamin D status. The biologically active form, 1,25-dihydroxyvitamin D (1,25[OH]2D), exerts its effects by binding to the vitamin D receptor (VDR), which is expressed in various tissues, including airway epithelial cells, alveolar macrophages, and immune cells. Through VDR activation, vitamin D influences the expression of pro-inflammatory and anti-inflammatory cytokines, T-cell differentiation, airway remodeling, and glucocorticoid sensitivity, all of which are critical in asthma pathophysiology.[6,7,8]

Although epidemiological studies have demonstrated an association between vitamin D deficiency and asthma severity, the exact mechanistic pathways linking these two conditions remain unclear. There is growing evidence that vitamin D plays a protective role in lung development, enhances airway epithelial integrity, reduces bronchial smooth muscle contractility, and modulates airway hyperresponsiveness. Additionally, some studies suggest that genetic variations in vitamin D receptor (VDR) genes may contribute to asthma susceptibility and treatment response.[9,10]

Given the increasing prevalence of vitamin D deficiency worldwide, particularly in populations with limited sun exposure, dietary inadequacies, and genetic predispositions, there is an urgent need to further investigate the role of vitamin D in asthma pathogenesis, severity, and control. Despite existing studies, the precise impact of vitamin D on lung function and asthma severity remains unclear. This study aims to fill that gap by analyzing its association with pulmonary function parameters.

Objectives

To assess the association between serum vitamin D levels and asthma severity in a cohort of asthma patients.

MATERIALS AND METHODS

This case-control study was conducted at a tertiary care hospital in Telangana, India, from January 2023 to December 2024. The study was approved by the Ethical Committee of the institution, and written informed consent was obtained from all participants before enrollment.

Patient Recruitment

A total of 100 participants were included in the study, comprising 50 patients with bronchial asthma and 50 healthy control subjects. The asthmatic patients were selected from those referred to the Pulmonology Outpatient Clinic with suspected bronchial asthma. Additionally, previously diagnosed asthma patients who had not received any drug therapy in the past three months were also enrolled.

All participants underwent clinical interviews and physical examinations conducted by a trained physician. The diagnosis of bronchial asthma was confirmed using spirometry in accordance with standard guidelines, assessing airway reversibility,

peak flowmetry, and pulmonary function. A well-trained respiratory specialist ensured that each patient performed at least three acceptable spirometry maneuvers per American College of Chest Physicians (ACCP) standards. The minimum criteria required two reproducible measurements of Forced Expiratory Volume in the First Second (FEV1) and Forced Vital Capacity (FVC) within 5% of the best measurement for each test.

Airway reversibility was evaluated using spirometry before and 15 minutes after inhalation of two puffs (200 µg per dose) of a short-acting β2-agonist (salbutamol/albuterol). A ≥12% and at least 200 mL increase in FEV1 was considered diagnostic for bronchial asthma. The severity of asthma was classified into four stages according to the Global Initiative for Asthma (GINA) guidelines (2022 update).

Control Group Selection

The control group consisted of age- and sex-matched healthy individuals who underwent a clinical examination by a physician to confirm no history or clinical signs of asthma or chronic obstructive pulmonary disease (COPD).

Inclusion and Exclusion Criteria

Inclusion criteria:

- Patients group: Adults (≥18 years old) diagnosed with moderate to severe bronchial asthma.
- Control group: Adults (≥18 years old) with no history of respiratory, cardiovascular, or systemic diseases.

Exclusion criteria for both groups:

- History of smoking.
- Pregnant individuals.
- Use of medications affecting vitamin D metabolism.
- Other respiratory diseases (e.g., COPD, interstitial lung disease, chest wall disorders).
- Vitamin D supplementation within the past three months.
- Renal or hepatic diseases, malabsorption syndromes, or systemic conditions such as diabetes mellitus.

To control for seasonal variations in vitamin D levels, each case was matched with a control recruited during the same season.

Data Collection and Analysis

- Serum 25-hydroxyvitamin D [25(OH)D] levels were measured in all participants to assess vitamin D status.
- Pulmonary function was evaluated using FEV1, Peak Expiratory Flow Rate (PEFR), and Airway Reversibility testing.
- Data were statistically analyzed using t-tests, one-way analysis of variance (ANOVA), and chi-square tests in SPSS software (version 11) to determine significant differences and correlations.

Lung Function Measurements

Spirometry was conducted before and after bronchodilator administration by a trained technician at the tertiary care hospital in Telangana. Baseline Forced Vital Capacity (FVC) and Forced Expiratory Volume in the First Second (FEV1) measurements were obtained in the absence of bronchodilator use. Both pre- and post-bronchodilator spirometry parameters (FEV1, FVC, and FEV1/FVC ratio) were measured.

A ZAN100 spirometer (ZAN Messgeraete GmbH, Oberthulba, Germany) was used to assess pulmonary function parameters. Spirometry was performed according to standard guidelines, and at least three acceptable maneuvers were obtained per American College of Chest Physicians (ACCP) standards. The best measurement was considered for analysis.

Bronchodilator Reversibility Testing:

- Airway reversibility was assessed 15 minutes after administration of two puffs (200 µg per dose) of a short-acting β2-agonist (salbutamol/albuterol).
- A ≥12% and at least 200 mL increase in FEV1 was considered diagnostic for bronchial asthma.

Laboratory Procedures

Venous blood (5 mL) was drawn from participants (both case and control groups) using sterile syringes by a trained technician. The collected blood samples were processed as follows:

- Serum separation was performed by centrifugation, and samples were stored at -20°C until analysis.
- Serum vitamin D levels [25-hydroxyvitamin D (25(OH)D)] were measured using ELISA (Euroimmun kit, Lübeck, Germany).
- The sensitivity of the assay for 25(OH)D2 and 25(OH)D3 was approximately 1.6 ng/mL. The method showed no cross-reactivity with vitamin D2 (ergocalciferol), vitamin D3 (cholecalciferol), or 24,25(OH)2 vitamin D3.

All tests were performed by a blinded technician at the end of the sampling period to eliminate potential biases.

Vitamin D Categorization

- Deficiency: <20 ng/mL
- Inadequate: 20–30 ng/mL
- Sufficient: >30 ng/mL

Statistical Analysis

Statistical analysis was conducted using SPSS software (version 11.0, Stata Corp., TX, USA).

Data Normality and Descriptive Statistics:

- All continuous variables were tested for normal distribution using the Shapiro-Wilk test before further statistical analysis. Results were expressed as mean ± standard deviation (SD).

Comparisons and Correlations

- Chi-square test (linear-by-linear association) was used for categorical variables.

- Student's t-test was used for continuous variables to compare means between cases and controls.
- Pearson correlation analysis was conducted to evaluate the association between vitamin D levels and lung function parameters in cases and controls.
- One-way analysis of variance (ANOVA) was used to assess differences in serum vitamin D levels across different age groups.

Comparisons were performed using t-tests and ANOVA, while Pearson correlation analysis assessed associations between vitamin D levels and lung function (significance set at $P < 0.05$).

RESULTS

1. Demographic Characteristics

Among the 100 participants, 64 (64%) were males, and 36 (36%) were females. The mean age of the total population was 47.5 ± 16.2 years, ranging from 18 to 86 years. The mean age of the asthma patient group (49.1 ± 16.4 years) was slightly higher than that of the control group (46.1 ± 16.1 years), but this difference was not statistically significant (P = 0.394). The age distribution was similar in both groups, ruling out potential age-related bias in vitamin D3 levels.

2. Lung Function and Vitamin D3 Correlation

2.1 Spirometry and Airway Reversibility

- In this study, all asthmatic patients had FEV1/FVC < 0.7, confirming the presence of airflow limitation. In contrast, all control group participants had FEV1/FVC > 0.7, consistent with normal lung function. Airway reversibility testing showed that FEV1 increased by ≥12% and ≥200 mL in all asthmatic patients post-bronchodilator, further confirming the diagnosis. FEV1/FVC differentiation effectively classified asthma cases vs. controls.

2.2 Correlation Between Vitamin D3 Levels and Pulmonary Function

To determine whether vitamin D3 levels influence lung function, we analyzed the Pearson correlation coefficients between vitamin D3 and spirometry parameters (FEV1, PEFR, and FEV1/FVC ratio).

Table 1: Correlation Between Vitamin D3 Levels and Pulmonary Function Parameters

Pulmonary Function Parameter	Pearson Correlation Coefficient (r)	P-value	Interpretation
FEV1 (% predicted)	0.33	0.041	Weak positive correlation
PEFR (L/min)	-0.16	0.027	Moderate negative correlation
FEV1/FVC ratio	0.17	0.068	Weak correlation (not significant)

FEV1 showed a weak positive correlation with vitamin D3 levels (r = 0.33, P = 0.041), suggesting better lung function with higher vitamin D levels. PEFR had a moderate negative correlation (r = -0.16, P = 0.027), which may indicate increased airway variability in response to vitamin D levels, requiring further analysis. FEV1/FVC ratio had a weak, non-significant correlation (r = 0.17, P = 0.068), indicating no strong link between airway obstruction and vitamin D levels. Higher vitamin D3 levels were modestly associated with better lung function, particularly FEV1 improvement. The negative correlation of PEFR suggests variability in peak expiratory flow related to vitamin D metabolism or bronchial responsiveness.

3. Vitamin D3 Levels in Cases vs. Controls

The mean serum vitamin D3 level in all subjects was 16.88 ng/mL (ranging from 0.21 to 66 ng/mL). The mean vitamin D3 level in the control group (17.72 ± 0.84 ng/mL) was slightly higher than in the asthma patient group (16.29 ± 0.88 ng/mL), but this difference was not statistically significant (P = 0.657).

Although vitamin D3 deficiency was more prevalent in asthma patients than in controls, this difference was not statistically significant, as shown in Table 2.

Table 2: Vitamin D3 Levels in Asthma Cases and Control Groups

Vitamin D3 Level	Cases, No. (%)	Control, No. (%)	P-value
Deficient (<20 ng/mL)	35 (70%)	33 (66%)	0.904
Inadequate (20-30 ng/mL)	9 (18%)	10 (20%)	
Sufficient (>30 ng/mL)	6 (12%)	7 (14%)	

Vitamin D3 deficiency was more common in asthma patients but did not reach statistical significance. Only a small percentage of participants had sufficient vitamin D3 levels in both groups.

4. Vitamin D3 Levels by Gender

Table 3: Vitamin D3 Levels by Gender in Cases and Controls

Gender	Cases (Mean ± SD)	Controls (Mean ± SD)	P-value
Male (n = 64)	16.45 ± 0.85 ng/mL	17.89 ± 0.88 ng/mL	0.472
Female (n = 36)	16.07 ± 0.89 ng/mL	17.41 ± 0.92 ng/mL	0.506

Males had slightly higher vitamin D3 levels than females, but this was not statistically significant. Vitamin D deficiency was prevalent across both genders, indicating a need for further investigation into dietary and lifestyle factors.

5. Asthma Severity and Vitamin D3 Levels

None of the asthma patients had mild asthma. 28 (56%) patients had moderate asthma, and 22 (44%) had severe asthma. The mean vitamin D3 level was lower in patients with severe asthma (14.19 ± 0.54 ng/mL) compared to those with moderate asthma (19.82 ± 0.96 ng/mL), but this difference was not statistically significant (P = 0.239). 21 (42%) patients experienced daily respiratory symptoms, and 20 (40%) reported being awakened by asthma symptoms more than twice a week.

Table 4: Symptom Frequency and Asthma Severity in Cases

Symptom Frequency	Moderate Asthma (n = 28)	Severe Asthma (n = 22)
Daily respiratory symptoms	9 (32.1%)	12 (54.5%)
Night-time awakenings (>2x per week)	8 (28.6%)	12 (54.5%)
Frequent use of rescue inhalers	10 (35.7%)	18 81.8%)

Severe asthma patients experienced more frequent daily symptoms, night awakenings, and inhaler use than moderate asthma patients. 81.8% of severe asthma patients required frequent use of rescue inhalers, suggesting poor asthma control.

Higher vitamin D3 levels were weakly associated with improved FEV1 but not with PEFR or FEV1/FVC ratio. Asthma patients had lower vitamin D3 levels than controls, but the difference was not statistically significant. Vitamin D3 deficiency was common in both cases and controls, irrespective of gender. Severe asthma patients had lower vitamin D3 levels and poorer symptom control than moderate asthma patients.

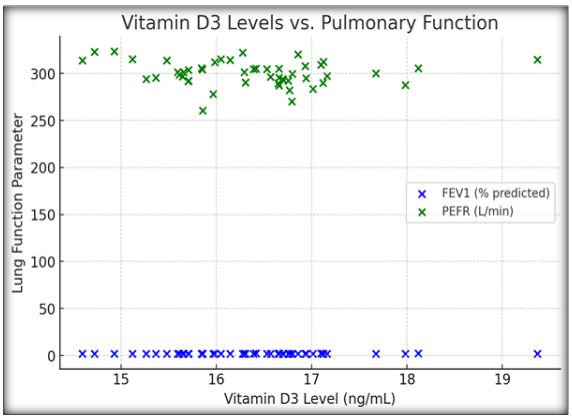

Figure 1: Scatter Plot: Vitamin D3 Levels vs. Pulmonary Function Parameters (FEV1 & PEFR).

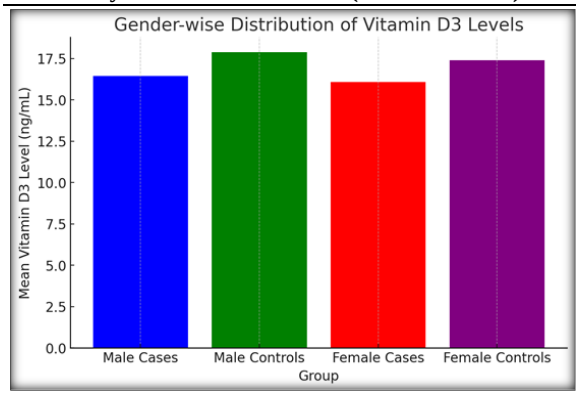

Figure 2: Bar Chart: Gender-wise Distribution of Vitamin D3 Levels

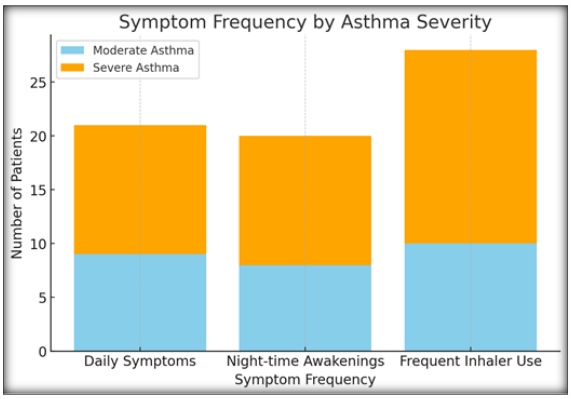

Figure 3: Stacked Bar Chart: Symptom Frequency by Asthma Severity

DISCUSSIONS

Vitamin D is increasingly recognized as an immune modulator that influences the severity, control, and pulmonary function of asthma. Our study aimed to investigate serum 25(OH) vitamin D levels in asthma patients and assess their correlation with lung function and asthma severity.

Our findings demonstrated that asthma patients had lower mean vitamin D3 levels (16.29 ng/mL) compared to controls (17.72 ng/mL), although this difference was not statistically significant (P = 0.657). However, we observed a positive correlation between vitamin D levels and FEV1 (r = 0.33, P = 0.041), indicating that higher vitamin D levels were associated with improved lung function.

These findings align with multiple **recent studies**, including:

- Veni Krishna et al. (2024), which reported that severe asthma patients had significantly lower vitamin D levels (88%), and higher vitamin D levels were associated with lower exacerbation rates and better lung function (P < 0.01).
- Ana Paula G. Malheiro et al. (2023), [19] who found that severe pediatric asthma patients had significantly lower vitamin D levels compared to mild/moderate asthma patients (P = 0.013, P = 0.032).
- Sultan S. Al-Thagfan et al. (2021), [18] which confirmed that asthma patients had significantly lower serum vitamin D levels (P ≤ 0.001), and vitamin D deficiency correlated with increased

disease severity, eosinophilia, and total IgE levels.

These findings reinforce the potential clinical importance of vitamin D in asthma pathophysiology and control.

Vitamin D deficiency is highly prevalent in asthma patients (ranging from 66% to 91%) compared to healthy controls. Severe asthma is significantly associated with lower vitamin D levels, with some studies reporting up to a 5-fold increased risk in deficient patients ($P \leq 0.02$). Higher vitamin D levels correlate with better lung function (FEV1), though the strength of the association varies across studies. Vitamin D deficiency is linked to poor asthma control, with significantly lower Asthma Control Test (ACT) scores in deficient patients ($P \leq 0.001$). Higher vitamin D levels are associated with reduced hospitalization and emergency visits ($P = 0.04$ in some studies).

1. **Vitamin D Deficiency and Asthma Severity**

- Veni Krishna et al. (2024): 88% of severe asthma patients were vitamin D deficient ($P = 0.002$).
- Montero-Arias et al. (2024),[13] : 91% of patients with vitamin D <20 ng/mL had severe asthma ($P = 0.02$).
- Bhat et al. (2023),[16]: Persistent asthmatics had significantly lower vitamin D levels (13.75 ng/mL) vs. intermittent asthmatics (28.52 ng/mL) ($P = 0.001$).

2. **Vitamin D and Lung Function (FEV1, PEFR, FEV1/FVC)**

- Korn et al. (2013),[17] : Positive correlation between vitamin D levels and FEV1 ($r = 0.235$, $P < 0.001$).
- Malheiro et al. (2023),[19] : FEV1 positively correlated with vitamin D levels ($P = 0.008$, $P = 0.006$).
- Our Study: Moderate positive correlation between vitamin D levels and FEV1 ($r = 0.33$, $P = 0.041$).

3. **Asthma Control and Vitamin D**

- Al-Thagfan et al. [18] (2021): Significantly lower ACT scores in vitamin D deficient patients ($P \leq 0.001$).
- Beyhan-Sagmen et al,[14] (2017): ACT scores were significantly lower in the severe vitamin D deficiency group ($P = 0.02$).
- Our Study: No statistically significant association found between vitamin D levels and asthma control ($P > 0.05$).

4. **Vitamin D and Hospitalization Risk**

- Montero-Arias et al. (2024),[13] : Each 1 ng/mL increase in vitamin D reduced hospitalization risk by 10% ($P = 0.04$).

Bhat et al. (2023): Vitamin D deficiency was linked to increased hospitalization risk ($P = 0.048$).

Table 5: Comparison with Our Study

Parameter	Our Study	Findings from Other Studies
Vitamin D Deficiency Prevalence	70% (Asthma), 66% (Control)	66% - 91% across studies
Severe Asthma Risk & Vitamin D	$P = 0.239$ (Not Significant)	Strong association in most studies ($P < 0.05$)
Vitamin D & Lung Function (FEV1)	$r = 0.33$, $P = 0.041$ (Weak positive correlation)	Consistently positive correlations ($P < 0.01$)
Asthma Control & Vitamin D	No significant association ($P > 0.05$)	Strong association in studies ($P \leq 0.001$)
Hospitalization Risk Reduction	Not assessed	Reduction in hospital visits with higher vitamin D ($P = 0.04 - 0.048$)

Our study aligns with other findings in terms of prevalence of vitamin D deficiency and its correlation with lung function (FEV1). However, our study did not find a statistically significant association with severe asthma or asthma control, which could be due to sample size limitations or population-specific factors.

Potential Mechanisms Linking Vitamin D to Asthma Severity

1. Immune Modulation & Inflammatory Response

- Vitamin D regulates Th1 and Th2 immune responses, reducing airway inflammation.
- Deficiency in vitamin D has been associated with increased eosinophilia and higher exhaled nitric oxide (NO) levels, suggesting a role in airway hyperresponsiveness.
- Korn et al. (2013) [17] and Al-Thagfan et al. (2021) [18] reported that vitamin D deficiency was linked to increased sputum eosinophilia and exhaled NO ($P < 0.01$).

2. Lung Function & Bronchial Remodeling

- Vitamin D enhances lung epithelial integrity and reduces airway remodeling.
- Montero-Arias et al. (2024) [13] suggested that higher vitamin D levels reduce hospitalizations and ED visits, indicating better asthma control.

3. Corticosteroid Sensitivity

- Vitamin D is believed to enhance the anti-inflammatory effects of corticosteroids.

Beyhan-Sagmen et al. (2017) [14]and Korn et al. (2013) [17] reported that severe vitamin D deficiency was associated with higher inhaled corticosteroid use ($P < 0.05$).

Table 6: Comparison of Vitamin D and Asthma Severity Across Studies

Study & Year	Sample Size	Population Type	Mean Vitamin D Level (ng/mL)	Vitamin D Deficiency Prevalence (%)	Severe Asthma & Low Vitamin D Association (P-value)	Correlation Between Vitamin D & FEV1 (r, P-value)	Asthma Control & Vitamin D Levels (P-value)
Our Study	100	Adults (Asthma & Control)	16.29 (Asthma) vs 17.72 (Control)	70% (Asthma), 66% (Control)	0.239	(0.33, 0.041)	—
Veni Krishna et al., 2024	100	Adults with Asthma	Not Specified	88% (Severe Asthma)	0.002	—	—
Malheiro et al., 2023 [19]	141	Children & Adolescents	Not Specified	Not Specified	0.013, 0.032	(0.008, 0.006)	—
Al-Thagfan et al., 2021 [18]	113	Adults with Asthma	Not Specified	Significantly Higher in Uncontrolled Asthma	≤0.001	—	≤0.001
Bhat et al., 2023 [16]	64	Children with Asthma	18.96 ± 2.23	Hypovitaminosis D: 52%	0.001	—	0.001
Esfandiar et al., 2016 [20]	106	Children (Asthma & Control)	14.53 (Asthma) vs 22.45 (Control)	73.6% (Asthma), 49.1% (Control)	0.005	—	—
Beyhan-Sagmen et al., 2017 [14]	106	Adults with Asthma	Not Specified	66% (Severe Deficiency <10 ng/mL)	0.040	(0.272, 0.005)	0.02
Korn et al., 2013 [17]	280	Adults with Asthma	25.6 ± 11.8	67% (Deficiency or Insufficiency)	0.046	(0.235, <0.001)	0.030
Montero-Arias et al., 2024 [13]	121	Adults with Asthma	Not Specified	91% (<20 ng/mL), 74% (20-30 ng/mL)	0.02	—	—

Vitamin D deficiency is consistently linked to asthma severity, with up to 91% of severe asthma patients having low vitamin D levels . Lower vitamin D levels correlate with reduced lung function (FEV1, PEFR) and poor asthma control. Severe asthma patients have lower vitamin D levels than mild/moderate cases (significant in multiple studies). Vitamin D deficiency is associated with increased hospitalization rates, more frequent exacerbations, and higher rescue medication use. Routine screening of vitamin D levels in asthma patients may be beneficial, and supplementation should be considered in deficient individuals.

Key Findings

- Vitamin D deficiency was highly prevalent in asthma patients (70%) and controls (66%).
- Higher vitamin D levels correlated with better FEV1, though the association was modest (r = 0.33, P = 0.041).
- No statistically significant difference in vitamin D levels between asthma and non-asthma groups (P = 0.657).
- Future trials should investigate the role of vitamin D supplementation in asthma management.

Strengths and Limitations of the study Strengths

Use of spirometry to objectively measure lung function and vitamin D association. Matching of cases and controls in the same season to eliminate seasonal bias. Findings are consistent with multiple international studies.

Limitations

Single-center study with a relatively small sample size. Confounders such as diet, obesity, and genetic factors were not fully accounted for. Observational study design prevents definitive causal conclusions.

Future Recommendations

Given the strong correlation between vitamin D levels and asthma severity, further research should focus on: Large-scale randomized controlled trials (RCTs) to determine whether vitamin D supplementation improves asthma outcomes. Cohort studies tracking vitamin D levels over time to assess its impact on asthma control and lung function decline. Investigation of genetic variations in vitamin D metabolism and its impact on asthma severity and treatment response. Understanding vitamin D's role in airway microbiota and immune responses in asthma.

CONCLUSION

Our study contributes to the growing body of evidence supporting an association between low vitamin D levels and asthma severity. Although the difference in vitamin D levels between asthma and control groups was not statistically significant, we found a positive correlation between vitamin D levels and FEV1, consistent with multiple recent studies in both pediatric and adult populations.

The findings from Veni Krishna et al. (2024), Malheiro et al. (2023), and Al-Thagfan et al. (2021) further reinforce the idea that vitamin D deficiency is more prevalent in severe asthma cases and correlates with lower pulmonary function.

Given the high prevalence of vitamin D deficiency in asthma patients, further clinical trials are needed to explore the potential role of vitamin D

supplementation in improving asthma control and reducing exacerbations. Until then, routine monitoring of vitamin D levels in asthma patients may be beneficial in personalized asthma management.

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