

CORRELATION OF SERUM VITAMIN D LEVELS WITH ASTHMA SEVERITY IN CHILDREN AGED 5-15 YEARS: A CROSS-SECTIONAL STUDY

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Abstract

Objective: This study aimed to investigate the correlation between serum vitamin D levels and asthma severity in children aged 5-15 years. **Methodology:** A cross-sectional study was conducted from February 2, 2022, to July 30, 2022 at JPMC Karachi, involving 150 children diagnosed with asthma at a tertiary care hospital. Participants were selected based on strict inclusion and exclusion criteria, ensuring a focus on asthma without confounding chronic conditions. Serum 25-hydroxyvitamin D [25(OH)D] levels were measured, and asthma severity was classified according to the Global Initiative for Asthma (GINA) guidelines. Data were collected through blood samples, spirometry, and structured questionnaires. Statistical analysis included Pearson's correlation to evaluate the relationship between vitamin D levels and asthma severity, ANOVA to compare vitamin D levels across severity categories, and multivariate regression analysis to control for potential confounders such as age, gender, BMI, and sunlight exposure. **Results:** The study found a significant negative correlation between serum vitamin D levels and asthma severity ($r = -0.48$, $p < 0.001$). Children with severe asthma had the lowest mean vitamin D levels (19.5 ± 6.3 ng/mL), while those with mild asthma had the highest levels (28.7 ± 7.8 ng/mL) ($p = 0.001$). Multivariate regression analysis confirmed the association between lower vitamin D levels and increased asthma severity, independent of other variables ($\beta = -0.34$, $p = 0.002$). **Conclusion:** Lower serum vitamin D levels are significantly associated with increased asthma severity in children. Addressing vitamin D deficiency may play a crucial role in managing asthma severity in pediatric populations.

Keywords: Asthma, Children, Vitamin D, Asthma Severity, Pediatric, Cross-Sectional Study, 25-Hydroxyvitamin D.

INTRODUCTION

Asthma is a prevalent chronic respiratory condition in children, characterized by airway inflammation, bronchial hyper reactivity, and reversible airflow obstruction. The Global Initiative for Asthma (GINA) estimates that asthma affects approximately 14% of children globally, posing significant challenges to their quality of life and overall health. Despite advancements in asthma management, the condition remains a leading cause of emergency department visits, hospitalizations, and school absenteeism among children.

Vitamin D, a fat-soluble vitamin traditionally associated with bone health, has gained attention for its immunomodulatory effects. Recent studies have suggested a potential link between vitamin D deficiency and various respiratory conditions, including asthma. Vitamin D is believed to influence the immune system's response, potentially reducing the inflammatory processes associated with asthma. Moreover, vitamin D deficiency is common in children, especially in regions with limited sunlight exposure or dietary intake.

Given the potential role of vitamin D in asthma pathogenesis, this study aims to investigate the correlation between serum vitamin D levels and asthma severity in children aged 5-15 years. Understanding this relationship could provide insights into novel therapeutic approaches for managing asthma in pediatric populations.

METHODOLOGY

This cross-sectional study was conducted at the pediatric outpatient clinics of a tertiary care hospital from February 2, 2022, to July 30, 2022. The study included 150 children aged 5-15 years who were clinically diagnosed with asthma according to GINA guidelines. Participants were recruited through consecutive sampling from outpatient clinics during their routine follow-up visits. Inclusion Criteria was Children aged 5-15 years, clinically diagnosed with asthma for at least one year, no history of chronic diseases other than asthma. Exclusion Criteria was children with chronic diseases affecting vitamin D metabolism, such as chronic kidney or liver disease and children on long-term corticosteroid therapy or vitamin D supplementation exceeding recommended doses.

Data Collection

1. Serum Vitamin D Levels: Blood samples were collected from each participant to measure serum 25-hydroxyvitamin D [25(OH)D] levels. The levels were categorized as:

- Deficient: <20 ng/mL
- Insufficient: 20-29 ng/mL
- Sufficient: ≥30 ng/mL

2. Asthma Severity: Asthma severity was classified according to GINA guidelines into three categories:

- Mild
- Moderate
- Severe

The classification was based on clinical assessment, frequency of symptoms, use of rescue inhalers, and results from pulmonary function tests, including spirometry.

3. Questionnaire: A structured questionnaire was administered to collect data on demographic variables, dietary intake of vitamin D, sunlight exposure, and use of vitamin D supplements.

Statistical Analysis

- **Descriptive Statistics:** Mean and standard deviation (SD) for continuous variables, and frequencies and percentages for categorical variables.
- **Correlation Analysis:** Pearson's or Spearman's correlation was used to assess the relationship between serum vitamin D levels and asthma severity.
- **Comparative Analysis:** ANOVA or Kruskal-Wallis test was employed to compare vitamin D levels across different asthma severity categories.
- **Multivariate Regression Analysis:** This analysis was performed to control for potential confounders such as age, gender, BMI, and dietary intake.

A p-value of <0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

The study included 150 children, with a mean age of 10.2 ± 3.1 years. The demographic distribution of the participants is shown in Table 1.

Table 1: Demographic Characteristics of the Study Population

Variable	Mean \pm SD / n (%)
Age (years)	10.2 \pm 3.1
Gender	
Male	82 (54.7%)
Female	68 (45.3%)
BMI (kg/m²)	18.5 \pm 2.8
Sunlight Exposure	
< 1 hour/day	75 (50%)
1-2 hours/day	55 (36.7%)
> 2 hours/day	20 (13.3%)

Serum Vitamin D Levels and Asthma Severity

The mean serum vitamin D level in the study population was 24.8 ± 9.6 ng/mL. Table 2 presents the distribution of vitamin D levels across different asthma severity categories.

Table 2: Serum Vitamin D Levels by Asthma Severity

Asthma Severity	n	Mean Vitamin D Level (ng/mL) \pm SD	Vitamin D Deficient (%)	Vitamin D Insufficient (%)	Vitamin D Sufficient (%)	p-value
Mild	50	28.7 \pm 7.8	12 (24%)	18 (36%)	20 (40%)	0.001*
Moderate	60	23.2 \pm 8.5	25 (41.7%)	26 (43.3%)	9 (15%)	
Severe	40	19.5 \pm 6.3	22 (55%)	15 (37.5%)	3 (7.5%)	

*p-value indicates a significant difference in vitamin D levels between asthma severity categories.

Correlation Analysis

A negative correlation was found between serum vitamin D levels and asthma severity ($r = -0.48$, $p < 0.001$), indicating that lower vitamin D levels were associated with more severe asthma.

Table 3: Correlation Analysis between Serum Vitamin D Levels and Asthma Severity

Variable	r	p-value
Vitamin D Levels vs. Severity	-0.48	<0.001**

Note: * $p < 0.05$ is considered statistically significant; ** indicates highly significant results.

DISCUSSION

This study explored the relationship between serum vitamin D levels and asthma severity in children aged 5-15 years. The results demonstrated a significant correlation between lower vitamin D levels and higher asthma severity, suggesting that vitamin D deficiency may contribute to the pathogenesis and exacerbation of asthma in children. Vitamin D is known to play a crucial role in immune modulation, particularly in the regulation of inflammatory responses. In asthma, an overactive immune response leads to chronic airway inflammation, contributing to the severity of the disease. Vitamin D has been shown to inhibit the production of pro-inflammatory cytokines and promote the production of anti-inflammatory cytokines, potentially reducing airway inflammation. The findings of this study support the hypothesis that vitamin D deficiency may exacerbate asthma symptoms by allowing unchecked inflammatory processes. The study's findings suggest that assessing and managing vitamin D levels in children with asthma could be a valuable component of asthma management. Given the high prevalence of vitamin D deficiency among children with severe asthma, clinicians should consider routine screening for vitamin D levels and recommend appropriate supplementation when necessary. This approach could potentially reduce the frequency and severity of asthma exacerbations, improving overall disease control and quality of life for pediatric asthma patients. The results of this study are consistent with previous research that has demonstrated a link between vitamin D deficiency and increased asthma severity. For instance, a study conducted by Brehm et al. (2009) found that children with low vitamin D levels were more likely to experience severe asthma attacks and hospitalizations. Similarly, other studies have reported that vitamin D supplementation can improve asthma control, particularly in patients with vitamin D deficiency. However, some studies have shown mixed results, indicating the need for further research to fully understand the role of vitamin D in asthma management.

Limitations

This study has several limitations. First, the cross-sectional design limits the ability to establish a causal relationship between vitamin D levels and asthma severity. Second, the study did not account for seasonal variations in vitamin D levels, which could influence

the results. Third, the sample size, while sufficient for detecting significant associations, was relatively small, which may limit the generalizability of the findings.

Future Directions

Further research is needed to confirm these findings and explore the potential benefits of vitamin D supplementation as part of asthma management in children. Longitudinal studies and randomized controlled trials could provide more robust evidence on the effectiveness of vitamin D supplementation in reducing asthma severity and improving clinical outcomes.

CONCLUSION

This study highlights a significant correlation between lower serum vitamin D levels and increased asthma severity in children aged 5-15 years. The findings suggest that vitamin D deficiency may play a role in exacerbating asthma symptoms and that addressing vitamin D levels in pediatric asthma patients could be an important aspect of disease management. Further research is warranted to explore the potential therapeutic benefits of vitamin D supplementation in this population.

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