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ORIGINAL ARTICLE

The Impact of Vitamin D Supplementation on Asthma Control in Children

TABASSUM BASHIR[1], ZOHA RAFAQAT[2], NAVEED LODHI[3], UROOJ YAHYA[4], HUSSAIN ALI[5], ARVA ZAHID[6]
[1]*Assistant professor Paediatrics, Nawaz Sharif Medical College, Gujrat.*
[2]*House Officer Aziz Bhatti Shaheed Teaching Hospital, Gujrat.*
[3]*Assistant Professor Biochemistry, Al Aleem Medical College Lahore*
[4]*Assistant Professor Physiology, Swat Medical College, Khyber Medical University, Peshawar.*
[5]*House Officer Shaikh Zayed Hospital*
[6]*Trainee Registrar Cardiology (FCPS)*
Corresponding author: Tabassum Bashir, Email: drtabassum511@yahoo.com, Cell: 03338405232

ABSTRACT

Introduction: Asthma is a common chronic respiratory condition affecting millions of children worldwide. Despite advancements in asthma management, many pediatric patients continue to experience suboptimal control, leading to frequent exacerbations, reduced quality of life, and increased healthcare utilization.

Objectives: The main objective of the study is to find the impact of vitamin D supplementation on asthma control in children.

Material and methods: A total of 175 pediatric patients aged 6 to 14 years were recruited from the pediatric respiratory clinic at Nawaz Sharif Medical College, Gujrat. Eligible participants were diagnosed with persistent asthma according to the Global Initiative for Asthma (GINA) guidelines. Patients with significant comorbidities, those on vitamin D supplementation, or with a history of vitamin D toxicity were excluded from the study.

Results: The study enrolled a total of 175 pediatric patients, with 87 participants in the intervention group and 88 in the control group. The mean age of the participants was 10 years, with a gender distribution of 55% male and 45% female. Baseline characteristics, including age, gender, and asthma severity, were comparable between the two groups. At baseline, the mean ACT score in the intervention group was 14.9, while in the control group, it was 14.7. The mean cACT score was 16.8 in the intervention group and 17.1 in the control group.

Practical Implication: This study will be helpful in finding the vitamin D supplementation on asthma control in children.

Conclusion: It is concluded that the impact of vitamin D supplementation on asthma control in children provides encouraging evidence for the potential benefits of vitamin D as an adjunctive therapy in pediatric asthma management. The 12-week intervention with daily vitamin D3 supplementation at a dosage of 1000 IU demonstrated significant improvements in asthma control scores and lung function parameters (FEV1 and FVC) in the intervention group compared to the control group.

Keywords: Vit-D, Asthma, Patients, Functions

INTRODUCTION

Asthma is a common chronic respiratory condition affecting millions of children worldwide. Despite advancements in asthma management, many pediatric patients continue to experience suboptimal control, leading to frequent exacerbations, reduced quality of life, and increased healthcare utilization. Vitamin D, a fat-soluble secosteroid, has gained considerable attention for its potential immunomodulatory and anti-inflammatory effects. Numerous studies have explored the relationship between vitamin D status and asthma outcomes in children, raising the question of whether vitamin D supplementation could play a role in improving asthma control[1].

Vitamin D is primarily synthesized in the skin through exposure to sunlight, and its active form, calcitriol, regulates calcium and phosphate metabolism, impacting bone health and other physiological processes. Beyond its classical role in calcium homeostasis, vitamin D has been shown to influence the immune system, modulating both innate and adaptive immune responses[2]. Specifically, vitamin D has been implicated in regulating T-cell differentiation and function, cytokine production, and the expression of genes associated with immune responses. As asthma is characterized by chronic airway inflammation and immune dysregulation, the potential immunomodulatory effects of vitamin D have sparked interest in its therapeutic potential for asthma management[3].

Several observational studies have reported an association between low vitamin D levels and increased asthma severity, exacerbations, and poor lung function in children. However, these findings do not establish causality, and it remains uncertain whether vitamin D deficiency is a risk factor for severe asthma or a consequence of the disease itself[4]. Interventional trials exploring the impact of vitamin D supplementation on asthma outcomes have yielded mixed results, with some studies suggesting potential benefits in terms of reduced exacerbations, improved lung function, and enhanced asthma control, while others have shown no significant effects. Over the past decade, the prevalence of asthma in children has continued to rise, creating a substantial public health burden. The quest for effective and safe therapeutic interventions has led researchers to explore novel approaches, including the potential use of vitamin D supplementation as an adjunctive therapy for asthma management[5].

The mechanistic rationale behind the hypothesized benefit of vitamin D lies in its influence on various components of the immune system. Preclinical studies have shown that vitamin D can suppress pro-inflammatory cytokines, promote regulatory T-cell function, and enhance antimicrobial peptide production in the respiratory tract. These immune-modulating properties suggest that vitamin D supplementation might mitigate airway inflammation and potentially improve asthma control[6]. Moreover, vitamin D deficiency is relatively common in many regions, particularly in those with limited sunlight exposure or in populations with specific dietary habits. The link between vitamin D status and asthma has sparked interest in exploring whether targeted supplementation could represent a cost-effective and accessible strategy to improve asthma outcomes in susceptible children. While initial observational studies have suggested a potential association between vitamin D deficiency and asthma severity, the results from interventional trials have been inconsistent, with varying effects on asthma control and exacerbation rates. The discrepancies in study findings could be attributed to differences in dosing regimens, participant characteristics, and underlying asthma phenotypes, highlighting the need for well-designed randomized controlled trials with standardized protocols[7].

Objectives: The main objective of the study is to find the impact of vitamin D supplementation on asthma control in children.

MATERIAL AND METHODS

A total of 175 pediatric patients aged 6 to 14 years were recruited from the pediatric respiratory clinic at Nawaz Sharif Medical College, Gujrat. Eligible participants were diagnosed with persistent asthma according to the Global Initiative for Asthma (GINA) guidelines. Patients with significant comorbidities, those on vitamin D supplementation, or with a history of vitamin D toxicity were excluded from the study.

Study Design: The research followed a randomized, double-blind, placebo-controlled design. Eligible participants were randomly assigned to either the intervention group or the control group. Randomization was performed using computer-generated random numbers, and allocation concealment was maintained throughout the study. Both patients and investigators were blinded to group assignments.

Intervention: The intervention group received oral vitamin D3 supplements at a dosage of 1000 IU per day for 12 weeks. The control group received identical-looking placebo capsules containing an inert substance. The vitamin D3 supplements and placebos were encapsulated in identical bottles to maintain blinding. Compliance was monitored through regular follow-up visits, during which participants were asked to return the bottles for pill count, and medication diaries were provided to record daily supplement intake.

Assessment of Asthma Control: Asthma control was assessed at baseline and after 12 weeks of intervention using standardized asthma control questionnaires. The primary outcome measures were the Asthma Control Test (ACT) for children aged 12 to 14 years and the Childhood Asthma Control Test (cACT) for children aged 6 to 11 years. The questionnaires assessed symptom frequency, medication use, and activity limitations over the past four weeks.

Lung Function Evaluation: Spirometry was performed to evaluate lung function at baseline and after 12 weeks of intervention. Forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) were measured using a spirometer following standard protocols.

Data Analysis: Data were analyzed using SPSS v20.0. Baseline characteristics between the intervention and control groups were compared using chi-square tests for categorical variables and t-tests for continuous variables. Changes in asthma control scores and lung function parameters within each group and between the groups were assessed using analysis of variance (ANOVA) with Bonferroni correction for multiple comparisons.

RESULTS

The study enrolled a total of 175 pediatric patients, with 87 participants in the intervention group and 88 in the control group. The mean age of the participants was 10 years, with a gender distribution of 55% male and 45% female. Baseline characteristics, including age, gender, and asthma severity, were comparable between the two groups. At baseline, the mean ACT score in the intervention group was 14.9, while in the control group, it was 14.7. The mean cACT score was 16.8 in the intervention group and 17.1 in the control group.

Table 1: Demographic characteristics of study participants

Group	Total Participants	Age (mean ± SD)	Gender (Male/Female)	Asthma Severity
Intervention	87	10.2 ± 2.1	47/40	Mild/Moderate
Control	88	10.0 ± 2.3	50/38	Mild/Moderate

Changes in Asthma Control Scores:

After 12 weeks of intervention, the intervention group demonstrated a statistically significant improvement in asthma control scores compared to the control group. The mean ACT score increased to 19.3 in the intervention group and 15.2 in the control group ($p < 0.001$). Similarly, the mean cACT score increased to 18.9 in the intervention group and 17.5 in the control group ($p = 0.002$).

Table 2: Baseline and post-intervention and asthma control

Group	Baseline ACT (mean ± SD)	Post-Intervention ACT (mean ± SD)	Baseline cACT (mean ± SD)	Post-Intervention cACT (mean ± SD)
Intervention	14.9 ± 2.3	19.3 ± 1.8	16.8 ± 2.0	18.9 ± 1.6
Control	14.7 ± 2.1	15.2 ± 2.4	17.1 ± 1.9	17.5 ± 2.0

Lung Function Parameters:

Baseline lung function parameters, including FEV1 and FVC, were similar between the intervention and control groups. After 12 weeks of intervention, the intervention group showed a significant improvement in lung function compared to the control group. The mean increase in FEV1 was 6.5% in the intervention group and 2.1% in the control group ($p < 0.001$). The mean increase in FVC was 5.8% in the intervention group and 1.9% in the control group ($p = 0.001$).

Table 3: Baseline and post-intervention lung function parameters

Group	Baseline FEV1 (mean ± SD)	Post-Intervention FEV1 (mean ± SD)	Baseline FVC (mean ± SD)	Post-Intervention FVC (mean ± SD)
Intervention	2.00 ± 0.25	2.13 ± 0.21	2.10 ± 0.23	2.22 ± 0.19
Control	2.01 ± 0.22	2.05 ± 0.23	2.08 ± 0.21	2.11 ± 0.20

Adherence to Supplementation:

The compliance with vitamin D supplementation in the intervention group was excellent, with 95% of participants reporting taking the supplements as prescribed. No significant adverse events related to vitamin D supplementation were reported during the study period. A subgroup analysis based on age and asthma severity showed consistent results, with all subgroups in the intervention group demonstrating improved asthma control scores and lung function compared to their respective control groups.

Table 4: Sub group analysis

Group	Age (years)	Mild Asthma (cACT)	Moderate Asthma (cACT)
Intervention	6-8	17.9 ± 1.7	18.4 ± 1.9
Intervention	9-11	18.8 ± 1.5	19.1 ± 1.4
Intervention	12-14	19.6 ± 1.8	20.2 ± 1.7
Control	6-8	16.5 ± 1.8	16.9 ± 1.9
Control	9-11	17.2 ± 1.6	17.4 ± 1.7
Control	12-14	15.8 ± 2.0	16.1 ± 1.9

Safety and Tolerability:

Vitamin D supplementation was well-tolerated in the intervention group, with no reports of hypercalcemia or other adverse effects related to supplementation.

Table 5: Subgroup Analysis of Changes in Lung Function Parameters (FEV1 and FVC) after Intervention

Group	Asthma Severity	Baseline FEV1 (mean ± SD)	Post-Intervention FEV1 (mean ± SD)	Baseline FVC (mean ± SD)	Post-Intervention FVC (mean ± SD)
Intervention	Mild Asthma	2.02 ± 0.24	2.15 ± 0.22	2.09 ± 0.23	2.20 ± 0.20
Intervention	Moderate Asthma	1.97 ± 0.27	2.11 ± 0.26	2.06 ± 0.25	2.18 ± 0.22
Control	Mild Asthma	2.00 ± 0.22	2.04 ± 0.23	2.07 ± 0.21	2.10 ± 0.20
Control	Moderate Asthma	2.02 ± 0.23	2.06 ± 0.24	2.09 ± 0.22	2.12 ± 0.21

DISCUSSION

Asthma is a complex and heterogeneous respiratory condition characterized by chronic airway inflammation and immune dysregulation. Despite advances in conventional asthma treatments, many pediatric patients still experience suboptimal asthma control, leading to frequent exacerbations and reduced quality of life. Therefore, the exploration of alternative therapeutic options, such as vitamin D supplementation, is of significant interest[8]. The findings from this study revealed that after 12 weeks of vitamin D supplementation, the intervention group showed a statistically significant improvement in asthma control scores (ACT and cACT) compared to the control group. This improvement in asthma control suggests that vitamin D supplementation may contribute to better symptom management and reduced asthma exacerbations in children with persistent asthma. Furthermore, the intervention group also demonstrated significant improvements in lung function parameters (FEV1 and FVC) after the 12-week intervention[9]. The enhancement in lung function indicates that

vitamin D supplementation may have a beneficial impact on respiratory function in pediatric asthma patients. Improving lung function is crucial for optimizing overall respiratory health and reducing the risk of acute exacerbations[10]. The subgroup analysis based on age and asthma severity revealed consistent results, with all subgroups in the intervention group experiencing improved asthma control scores and lung function compared to their respective control groups. These findings suggest that vitamin D supplementation may be effective across different age groups and asthma severity levels, making it a potentially promising adjunctive therapy for a wide range of pediatric asthma patients[11]. The observed safety and tolerability of vitamin D supplementation in the intervention group are noteworthy. No significant adverse events related to supplementation were reported during the study, indicating that vitamin D supplementation at the provided dosage (1000 IU per day) was well-tolerated and did not cause any harm to the participants. Although this study has yielded encouraging results, some limitations need to be acknowledged[12]. First, the study's duration was limited to 12 weeks, and long-term effects of vitamin D supplementation were not explored. Further studies with extended follow-up periods are necessary to evaluate the sustainability of the observed benefits. Second, the sample size was relatively small, and larger-scale trials with diverse populations are warranted to confirm the findings and improve the generalizability of the results. Additionally, the study did not assess other potential confounding factors, such as dietary habits, sun exposure, and other vitamin D-related genetic factors, which could influence the outcomes[13].

CONCLUSION

It is concluded that the impact of vitamin D supplementation on asthma control in children provides encouraging evidence for the potential benefits of vitamin D as an adjunctive therapy in pediatric asthma management. The 12-week intervention with daily vitamin D3 supplementation at a dosage of 1000 IU demonstrated significant improvements in asthma control scores and lung function parameters (FEV1 and FVC) in the intervention group compared to the control group. The findings from this study suggest that vitamin D supplementation may contribute to enhanced asthma control, leading to improved symptom management and reduced asthma exacerbations in children with persistent asthma. Additionally, the observed improvements in lung function parameters highlight the potential of vitamin D to positively impact respiratory health in pediatric asthma patients.

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