



RELATION BETWEEN VITAMIN D DEFICIENCY AND ASTHMA SEVERITY IN CHILDREN ADMITTED IN DMCH

Pediatrics

Dr Ankur Agrawal	PG student, Department of Pediatrics, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India.
Dr Vivekanand Paul*	Senior Resident, Department of Pediatrics, Darbhanga Medical College and Hospital, Laheriasarai, Bihar, India. *Corresponding Author
Dr Sachin Kumar	PG student, Department of Pediatrics, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India.

ABSTRACT

Objectives: The objective of the study was to determine the relation between Vitamin D deficiency and asthma severity in children admitted in DMCH. **Materials And Methods:** Data were collected from the inpatient and outpatient Department of Paediatrics, DMCH, Laheriasarai. **Results:** Out of 150 asthmatic children, vitamin D deficient level was seen in 85 (56.7%) children, insufficient level of Vitamin D was seen in 33 (22%) children and sufficient level of Vitamin D was seen in 32 (21.3%) children. Out of 150 healthy controls, vitamin D deficient level was seen in 63 (42%) children, insufficient level of Vitamin D was seen in 27 (18%) children and sufficient level of Vitamin D were seen in 60 (40%) children. Out of 111 children of intermittent asthma, deficient level of vitamin D was seen in 65 (58.6%) children, insufficient level was seen in 22 (19.8%) children and sufficient level was seen in 24 (21.6%) children. Out of 28 children of mild persistent asthma, deficient level of Vitamin D was seen in 15 (53.6%) children, insufficient level was seen in 8 (28.6%) children and sufficient level was seen in 5 (17.8%) children. Out of 11 children of moderate persistent asthma, deficient level of Vitamin D was seen in 5 (45.4%) children, insufficient level was seen in 3 (27.3%) children and sufficient level was seen in 3 (27.3%) children. **Conclusion:** Vitamin D supplementation in asthmatic children might reduce airway inflammation probably by reducing the production of IgE level or eosinophils count and this could be therapeutically effective in preventing or reversing allergic airway inflammation and airway hyper-responsiveness.

KEYWORDS

Vitamin D, Asthma, Airway hyper responsiveness

INTRODUCTION

Asthma is a chronic disorder of the conducting airways which is characterized by reversible airway obstruction, cellular infiltration and airway inflammation. The response involves the interplay of genetic and environmental factors as well as the activation of cells in the innate and adaptive immune systems.¹

The etiology of asthma is complex and likely involves multiple interactions between genetic and environmental factors. Environmental factors such as atmospheric pollution, dietary changes, allergen-sensitization, and lifestyle modifications may be responsible for the increasing prevalence of asthma.²

Airway remodeling, an important feature of severe persistent asthma that includes Airway smooth muscle hyperplasia, is modulated by Vitamin D since growth factor-induced Airway smooth muscle proliferation was inhibited by Vitamin D treatment.³

Vitamin D is a generic term for the two major forms of vitamin D; ergocalciferol (Vitamin D₂) is derived from plants and only available as a supplement. Cholecalciferol (Vitamin D₃) is created by exposure of the skin to UV-B radiation, and is also available through supplements, supplemented foods, and naturally through a few foods (such as cod liver oil). Both of these forms of Vitamin D are hydroxylated in the liver to form 25-hydroxyvitamin D₂ or D₃ (25-OH-vitamin D), which are the main circulating forms of vitamin D, and used by most investigators as the primary markers of vitamin D sufficiency.⁴

Vitamin D deficiency shares risk factors with several other socio-demographic risk factors for asthma, such as African American or Puerto Rican ethnicity, obesity, and inner city residence.⁵ In addition to this, children have been spending more time indoors during the day due to school, video games, and television.⁶ This has led to the hypothesis that vitamin D deficiency may play a role in asthma pathogenesis.

The aim of the study is to find the relationship between Vitamin D deficiency and severity of childhood asthma in children in DMCH.

MATERIALS AND METHODS

The study was carried out in the Department of Paediatrics, Darbhanga Medical Hospital, Laheriasarai. Permission from the hospital authority and ethical committee was taken before conducting the study.

A total of 300 children age 5 years to 12 years from inpatient and outpatient of department of Paediatrics were included in the study. These children were divided into two groups, 150 children in each group with serum vitamin D level lower than 20 ng/ml. Group A with 150 children, were diagnosed as an Asthmatic children according to the clinical criteria and classified with GINA guideline.⁷ Group B with 150 children were healthy controls. A detailed informed consent was taken from the mothers whose child was included in the study. All asthmatic children were on appropriate treatment according to the GINA guidelines.⁷

Children with no history of allergic diseases and negative atopic family history were enrolled as healthy controls. Children presenting with other chronic respiratory disease, history of consumption of any supplements of vitamin D due to any cause and drugs that modulate serum vitamin D levels were excluded from the study.

Children that were included in the study, from their mothers a detailed history was taken and thorough physical examination of the children was performed. Case history information included family history, birth history, allergic history, socioeconomic history and detailed dietary history of children. Blood sample approx 2ml was collected by the venipuncture in the cubical fossa of each children.

The values for Vitamin D levels ≥ 30 ng/ml were considered as sufficient, between 20 and 30 ng/ml as insufficient and lower than 20 ng/ml as deficient.⁸

Laboratory tests results were communicated to the parents of children. A p-value of <0.05 was considered as statistically significant.

RESULTS

A total of 352 children were screened during the study. Out of which 300 children were included in the study, which were divided into two groups, 150 children in each group. A total of 52 children were excluded from the study.

Out of 150 children in group A which were asthmatic children, 106 (70.7%) children were male child and 44 (29.3%) children were female child. Out of 150 children in group B which were healthy controls, 103 (68.7%) children were male child and 47 (31.3%) children were female child. Out of 150 asthmatic children, average value of vitamin D level was 20.34 and out of 150 healthy control it was 25.39 which was statistically significant (Proportion test, p-value: 0.01).

Out of 150 asthmatic children, vitamin D deficient level was seen in 85 (56.7%) children, insufficient level of vitamin D was seen in 33 (22%) children and sufficient level of vitamin D was seen in 32 (21.3%) children. Out of 150 healthy controls, vitamin D deficient level was seen in 63 (42%) children, insufficient level of vitamin D was seen in 27 (18%) children and sufficient level of vitamin D were seen in 60 (40%) children. It was statistically significant (proportion test, P-value 0.002). **Table 1**

The Intermittent asthma was assayed in 111 (74%) children, mild persistent asthma was in 28 (18.7%) children and moderate persistent asthma in 11 (7.3%) children according to GINA guidelines. Out of 111 children of intermittent asthma, deficient level of vitamin D was seen in 65 (58.6%) children, insufficient level was seen in 22 (19.8%) children and sufficient level was seen in 24 (21.6%) children. Out of 28 children of mild persistent asthma, deficient level of vitamin D was seen in 15 (53.6%) children, insufficient level was seen in 8 (28.6%) children and sufficient level was seen in 5 (17.8%) children. Out of 11 children of moderate persistent asthma, deficient level of vitamin D was seen in 5 (45.4%) children, insufficient level was seen in 3 (27.3%) children and sufficient level was seen in 3 (27.3%) children. There was no difference between the concentration of vitamin D in the serum and the severity of asthma, as it was statistically insignificant (proportion test, P-value 0.8). **Table 2**

Table 1: Comparison Of Serum Vitamin D Levels In Asthmatic Patients And Healthy Controls

Vitamin D level	Asthmatic children	Healthy controls	P-value
Deficient <20 ng/ml	85(56.7%)	63(42%)	0.002
Insufficient 20-30 ng/ml	33(22%)	27(18%)	
Sufficient >30 ng/ml	32(21.3%)	60(40%)	

Table 2: Relationship Between Serum Level Of Vitamin D And Asthma Severity

Vitamin D level	Intermittent Asthma	Mild persistent Asthma	Moderate persistent Asthma	P-value
Deficient <20ng/ml	65(58.6%)	15(53.6%)	5(45.4%)	0.8
Insufficient 20-30ng/ml	22(19.8%)	8(28.6%)	3(27.3%)	
Sufficient >30ng/ml	24(21.6%)	5(17.8%)	3(27.3%)	

DISCUSSION

Studies have shown the relation between the low serum levels of vitamin D and the prevalence of asthma with especial reference to immunomodulatory effects of vitamin D on the lungs.⁹⁻¹⁰

In the study, it was found that prevalence of vitamin D deficiency was more in asthmatic children in compare to healthy controls. Also it was found that serum level of vitamin D in asthmatic children were lower than the healthy controls. This result was similar to the result obtained in the study done by Freishtat et.al.¹¹ This result can be explained due to asthmatic children spend less time outdoor because of exposure to allergen and so they are less exposed to sunshine.

Vitamin D exerts its effects through the VDR which has been identified on several cells types that mediate allergic airway inflammation. Using a mouse model fed on different vitamin D diets, vitamin D deficiency decreased the expression of VDR in the airways of mice following allergen exposure.¹² Further examination of hallmark features of asthma revealed that vitamin D deficiency was associated with higher AHR, increased airway remodeling, bronchoalveolar lavage fluid (BALF) eosinophilia and a reduction in T regulatory cells in the blood when compared to vitamin D sufficient (10,000 IU/kg) groups. Vitamin D deficiency also resulted in increased expression of the NF- κ B subunits importin α 3 and Rel-A which corresponded with increased pro-inflammatory cytokines and reduced IL-10 levels in BALF.¹³ As seen in animal studies, treatment of passively sensitized human ASM cells (HASM) with 1,25-dihydroxyvitamin D was found to significantly reduce the binding capacity of NF- κ B and inhibited translocation to the nucleus. 1,25(OH)2D3 also increased the stability of I κ B α mRNA with reduced phosphorylation of I κ B α resulting in increased I κ B α expression in these cells.¹⁴

Vitamin D deficiency or insufficiency and severity of asthma, which was not similar to the results found in the other studies.¹⁵ It other studies it was found that, vitamin D deficiency or insufficiency due to down-regulation of glucocorticoid pathways leads to the need for increased steroid doses and this may itself increase asthma severity.¹⁶ Moreover, other studies have shown that respiratory infections such as rhinoviruses enhance allergic airway inflammation, reduce pulmonary function and increase asthma exacerbation severity, especially in asthmatic patients having vitamin D deficiency or insufficiency.¹⁷

In addition to the critical role that vitamin D plays in calcium and phosphorus homeostasis, it regulates signaling pathways in many cells and tissues, indicating that vitamin D may limit prohypertrophic signaling associated with excessive airway hyper-responsiveness.¹⁸ However, many more studies are needed to determine the relationship between vitamin D levels and airway smooth muscle and epithelial cell biology in asthma.

CONCLUSION

From the study we conclude that, asthmatic children are not very much exposed to the sunshine, so there is higher incidence of vitamin D deficiency in asthmatic children. Therefore, vitamin D supplementation in asthmatic children might reduce airway inflammation probably by reducing the production of IgE level or eosinophils count and this could be therapeutically effective in preventing or reversing allergic airway inflammation and airway hyper-responsiveness.

REFERENCES

- Hall SC, Fischer KD, Agrawal DK. The impact of vitamin D on asthmatic human airway smooth muscle. *Expert Rev Respir Med*. 2016;10(2):127-135.
- Van Der Werff SD, Junco Diaz R, Reyneveld R, et al. Prediction of asthma by common risk factors: a follow-up study in Cuban schoolchildren. *J Investig Allergol Clin Immunol* 2013; 23: 415-420.
- Song Y, Qi H, Wu C (2007) Effect of 1,25-(OH)2D3 (a vitamin D analogue) on passively sensitized human airway smooth muscle cells. *Respirology* 12: 486-494.
- Holick MF. Vitamin D deficiency. *N Engl J Med*. 2007;357(3):266-281.
- Masoli M, Fabian D, Holt S, Beasley R. The global burden of asthma: executive summary of the GINA Dissemination Committee report. *Allergy*. 2004;59(5):469-478.
- Dollman J, Norton K, Norton L. Evidence for secular trends in children's physical activity behaviour. *British journal of sports medicine*. 2005;39(12):892-897. discussion 897.
- Guide for asthma management and prevention (GINA website). Available at: www.ginasthma.org.
- Maalmi H, Berriaes A, Tangour E, et al. The impact of vitamin D deficiency on immune T cells in asthmatic children: a case-control study. *J Asthma Allergy* 2012;5:11-9.
- Adams JS, Hewison M. Unexpected actions of vitamin D: new perspectives on the regulation of innate and adaptive immunity. *Nat Clin Pract Endocrinol Metab* 2008; 4(2):80-90.
- Rajabik MH, Lotfi T, Alkhaled L, et al. Association between low vitamin D levels and the diagnosis of asthma in children: a systematic review of cohort studies. *Allergy Asthma Clin Immunol* 2014;10(1):31.
- Freishtat RJ, Iqbal SF, Pillai DK, et al. High prevalence of vitamin D deficiency among inner-city African American youth with asthma in Washington, DC. *J Pediatr* 2010; 156(6):948-52.
- Agrawal T, Gupta GK, Agrawal DK. Vitamin D deficiency decreases the expression of VDR and prohibit in the lungs of mice with allergic airway inflammation. *Exp Mol Pathol*. 2012;93(1):74-81.
- Agrawal T, Gupta GK, Agrawal DK. Vitamin D supplementation reduces airway hyperresponsiveness and allergic airway inflammation in a murine model. *Clin Exp Allergy*. 2013;43(6):672-683.
- Song Y, Hong J, Liu D, Lin Q, Lai G. 1,25-dihydroxyvitamin D3 inhibits nuclear factor kappa B activation by stabilizing inhibitor I κ B α alpha via mRNA stability and reduced phosphorylation in passively sensitized human airway smooth muscle cells. *Scand J Immunol*. 2013;77(2):109-116.
- Brehm JM, Celedon JC, Soto-Quiros ME, et al. Serum vitamin D levels and markers of severity of childhood asthma in Costa Rica. *Am J Respir Crit Care Med* 2009;179(9):765-71.
- Searing DA, Zhang Y, Murphy JR, et al. Decreased serum vitamin D levels in children with asthma are associated with increased corticosteroid use. *J Allergy Clin Immunol* 2010;125(5):995-1000.
- Busse WW, Lemanske RF Jr, Gern JE. Role of viral respiratory infections in asthma and asthma exacerbations. *Lancet* 2010;376(9743):826-34.
- Gerber AN, Sutherland ER. Vitamin D and asthma: another dimension. *Am J Respir Crit Care Med* 2011;184(12):1324-5.

In the study, it was found that there was no relationship between