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A study to assess the level of Vitamin D status and its association with the severity of the pneumonia

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Abstract

Background: The effects of Vitamin D on bone metabolism and calcium homeostasis have already been well recognized. Emerging evidence has implicated Vitamin D as a critical regulator of immunity, playing a role in both the innate and cell-mediated immune systems. Emerging evidence has implicated Vitamin D as a critical regulator of immunity, playing a role in both the innate and cell-mediated immune systems. Vitamin D deficiency has been found to be associated with several immune-mediated diseases, susceptibility to infection and cancer. Further elucidation of the role of Vitamin D in lung development and immune system function may hold profound implications for the prevention and treatment of asthma.
Objective: To study the Vitamin D Status of children having severe pneumonia and to know if there is any relation between Vitamin D levels and severe pneumonia.
Methodology: The present prospective study was conducted by the department of Pediatrics at SCBMCH & SVVPGIP, Cuttack from October 2013 to October 2015 among the children with the age group of 1 to 5 years of age who were admitted in the department with complains of Pneumonia. A total of 80 children who were having severe and very severe pneumonia diagnosed based on WHO ARI (acute respiratory tract infection) criteria admitted to the SCBMCH & SVVPGIP (General, Pay ward & PICU) in the age group of 1 to 5 years.
Results: In this study, we found that 50% of the children among cases had vitamin D levels in the deficiency range while 41.3% and in the insufficiency group while we had 8.8% of the children in the sufficiency group as compared to the healthy controls 20(71.4%) among 28 belongs to sufficient age group, 5(17.9%) to insufficient group and 3(10.7%) to the deficient group. One significant finding in this study was that out of the 27 children in the sufficiency group none of them were there in the very severe pneumonia group which suggests as the Vitamin D levels Increases the severity of the condition decreases.
Conclusion: In this study, we found that Vitamin D levels were related to severity of the disease as there were no children in the sufficiency group having very severe pneumonia. Hence we can say as the levels of Vitamin D falls the severity of pneumonia Increases.

Keywords: Vitamin D, pneumonia, acute respiratory infection

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Introduction

Acute lower respiratory infection (ALRI), primarily pneumonia, is a common cause of morbidity and mortality in children younger than 5 y of age, particularly in developing countries. Consequently, considerable research has aimed at finding effective interventions against ALRI such as immunization and case management involving antibiotics. Micronutrient supplementation is another potential intervention. Many trials have investigated the benefits of vitamin A supplements, but these do not significantly decrease morbidity and mortality from ALRI, other than that due to measles, in spite of decreasing overall under-5 mortality [1]. In developing countries. Oral zinc reduces mortality among children with clinically defined severe pneumonia [2].

Clinical vitamin D deficiency (rickets) was associated with 13-fold increased risk of pneumonia and severity of pneumonia [3].

The effects of Vitamin D on bone metabolism and calcium homeostasis have already been well recognized. Emerging evidence has implicated Vitamin D as a critical regulator of immunity, playing a role in both the innate and cell-mediated immune systems. Vitamin D deficiency has been found to be associated with several immune-mediated diseases, susceptibility to infection and cancer. Further elucidation of the role of Vitamin D in lung development and immune system function may hold profound implications for the prevention and treatment of asthma [4]. Initial direct evidence implicating Vitamin D in asthma and allergy development came from human genetic association studies.

Increasing evidence implicates a complex role for Vitamin D in the regulation of immune responses. Multiple immune cell types express Vitamin D receptors (VDR), including activated T cells, B cells, macrophages and dendritic cells. More recently, Vitamin D has been reported to inhibit IL-17 (Interleukin-17) production that is involved in pneumonia. Vitamin D inhibits Th2 (T-Helper 2) cells inhibiting production of cytokines such as IL-4, IL-5 IL-13 and IgE (Immunoglobulin E) by B cells, mast cells and eosinophils. As there are very few studies available in Indian literature linking the Vitamin D levels and pneumonia, this study is being conducted to find out the relation between Vitamin D levels and severity of pneumonia [5].

Objectives

To study the Vitamin D Status of children having severe pneumonia and to know if there is any relation between Vitamin D levels and severe pneumonia.

Materials and Methods

The present prospective study was conducted by the department of Pediatrics at SCBMCH & SVVPGIP, Cuttack from October 2013 to October 2015 among the children with the age group of 1 to 5 years of age who were admitted in the department with complains of Pneumonia.

A total of 80 children who were having severe and very severe pneumonia diagnosed based on WHO ARI (acute respiratory tract infection) criteria admitted to the SCBMCH & SVVPGIP (General, Pay ward & PICU) in the age group of 1 to 5 years. Consent was taken from the Parents, detailed history taken using a structured questionnaire, clinical examination done. Following investigations were done: chest x-ray & Vitamin D levels (ELISA).

Inclusion criteria

- Children in the age group 1-5 years of either sex are taken into the study.

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- Children only with Clinical diagnosis of severe pneumonia [clinical presentation with cough, fever, tachypnea and crepitations on auscultation, along with presence of either lower chest indrawing or at least one other danger sign (inability to feed, lethargy, cyanosis)] as per WHO Guidelines for ARI control program.

Exclusion criteria

- Children with Bronchial Asthma.
- Children with Bronchiolitis.
- Infants and children more than 5 years.

Sample size

80 Cases admitted in SCBMCH & SVPPGIP in the specified time period with severe pneumonia and very severe pneumonia will be taken into the study.
80 healthy controls who has attended OPD in the same specified time, of same age group was taken.

25(OH)D_3 estimation

Blood sample for estimation of 25(OH)D_3 was collected during PICU stay. 2ml of blood was collected in a plain vial and sent to the laboratory. After collection of blood serum was separated by centrifuging the sample at 30000 rpm. Then stored at -20 ^oC till estimation of 25 (OH)D_3. We used sandwich ELISA for estimation of 25 (OH)D_3 level. No patient was imposed by any excessive cost or hazard for mere study.
Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Chi-square/Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

Results

A total of 80 study subjects in case group and 80 study subjects with control were selected for the purpose of the study.

Table 1

		No. of patients	% (cases)	No. of Control	%(controls)
Age in yrs.	1-2	29	36.3	30	37.5
	>2-4	41	51.2	40	50
	>4-5	10	12.5	10	12.5
Gender	Male	42	52.5	54	67.5
	Female	38	47.5	26	32.5

out of 160 children studied,80 were cases & 80 belongs to control group. Among cases 29(36.2%) were in the age group 1-2yrs and 41(51.2%) in the age group 2-4yrs and 10(12.5%) in the 4-5yrs & among controls 30(37.5%) were in the age group 1-2yrs, 40(50%) in the age group 2-4yrs & 10(12.5%) in the age group 4-5 yrs. The mean age in our study was 2.57 years.
Out of the 160 children studied 42 were males cases and 38 were female cases that is 52.5% and 47.5% respectively & 54 were males controls & 26 were females controls that is 67.5% & 32.5% respectively.

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Table 2: Sunlight exposure of patients studied

Sun exposure	Cases			Controls		
	Male	Female	total	Male	Female	Total
Yes	29(69%)	21(55.3%)	50(62.5%)	44(81.4%)	16(61.5%)	60(75%)
No	13(31%)	17(44.7%)	30(37.5%)	10(38.5%)	10(38.5%)	20(25%)
Total	42(100%)	38(100%)	80(100%)	54(100%)	26(100%)	80(100%)

In this study population sunlight exposure and relation to sex was; among cases 69% males were exposed to sunlight as compared to females it was 55.3% & among controls 81.4% males were exposed to sunlight as compared to females it was 61.5%. Among the cases the association was found to be statistically insignificant.

Table 3: Acute respiratory infection of cases studied

ARI	Gender		Total
	Male	Female	
Severe Pneumonia	34(81%)	32(84.2%)	66(82.5%)
Very Severe Pneumonia	8(19%)	6(15.8%)	14(17.5%)
Total	42(100%)	38(100%)	80(100%)

p=0.702, Not significant, Fisher Exact test.

In this study population children were divided into 2 groups according to ARI (WHO) that is severe pneumonia 66(82.5%) children and very severe pneumonia 14(17.5%) children were more in the severe pneumonia group.

Table 4: Vitamin D Status of Study Group

Vitamin D Level	Deficiency	Insufficiency	Sufficiency	Total
No of cases	40(50%)	33(41.2%)	7(8.8%)	80(100%)
No of controls	3(10.7%)	5(17.9%)	20(71.4%)	28(100%)

The above table shows Vitamin D status among studied children, where 50 of the cases were in the deficiency group, 41.2% in the insufficiency group and 8.8% in the sufficiency group & 71.4% controls were in sufficiency group, 17.9% in insufficiency & 10.7% were in deficiency group.

Table 5: ARI findings of patients studied with Vitamin D levels

ARI	Vitamin D			Total
	Deficiency	Insufficiency	Sufficiency	
Severe Pneumonia	29(72.5%)	30(90.9%)	7(100%)	66(82.5%)
Very Severe Pneumonia	11(27.5%)	3(9.1%)	0(0%)	14(17.5%)
Total	40(100%)	33(100%)	7(100%)	80(100%)

p=0.067+, significant, Chi-square test.

ARI criteria and Vitamin D levels of these children were as follows with children in the deficiency group 72.5% were in the severe pneumonia group and 27.5% in the very severe pneumonia group.

Discussion

Major source of Vitamin D for our body is cutaneous synthesis through the effect of UVR on 7 de hydro cholesterol because dietary source through fatty fishes, organ meat, egg yolk, cod liver oil and milk products does not contribute significantly as these are not consumed in

sufficient quantities by children. Thus fortifying foods with vitamin D remains the only alternative in case cutaneous Synthesis is inadequate. It is surprising and disturbing to note that hypovitaminosis D is highly prevalent even in areas with adequate sunshine. Pediatricians and health policy makers to this fact has important implications on child health, as widely held notion that Vitamin D supplementation is not necessary in sun replete areas is preventing policy makers from coming out with definite guidelines regarding Vitamin D requirements [6, 7, 8].

In this study, we found levels of Vitamin D was more in the levels of deficiency for 40 (50%) children and insufficiency range for 33 (41.3%) children and sufficiency range for 7 (8.8%) children which was far below the levels which was expected in our country as it's a country with adequate sunlight exposure still the Vitamin D levels in these children were found to be low as compared to other tropical countries.

In our study the mean vitamin D Levels was found to be 20.02mg/dl which is much lesser when compared to other studies done in Brehm *et al*. [9] and CAMP study [10]. The respiratory disorders in association with vit D levels it was found that in our study nearly 50% of them who had respiratory disorders had deficient Vitamin D levels, 41.3% had insuffucienct Vitamin D level and 8.8% had suffienct Vitamin D levels. In the Brehm *et al*. [9] study 28% of them had insufficient Vitamin D levels and 72% has Sufficient Vitamin D levels. In Bener *et al*. [11] study 41% of the subjects had deficient vitamin D levels, 18% had insufficiency Vitamin D levels and 13% had sufficient Vitamin D Levels among those who had respiratory disorders.

In our study, the mean age was 2.57 as compared to 1.99yrs in V Wayse *et al*. [12] where the children were from 1 year to 5 years age were taken and who fell in the criteria of severe and very severe pneumonia. In the deficiency group majority of cases were in age group 2-4 yrs that is 55 %, same was the findings in the insufficiency group with 48.5% in the age group 2-4yrs, in the sufficiency group it was almost equally distributed and among controls majority of sufficient 50% were in age group 1-2yrs and deficieny age group among controls was 2-4yrs (66.7%) In the study V Wayse *et al*. [12] they found as the age progresses the mean Vitamin D level also increases in their study in the age group 2-4 yrs 40% had deficiency of the Vitamin.

In our study also we found the same finding as the age progresses the mean Vitamin D level also Increases.

In this study, the male to female ratio was 1.1: 1 respectively. In which 54% had Vitamin D levels in the deficiency range and 38% insufficiency and 7% in the sufficiency range among male cases and 83% in sufficient group, 11% in insufficient group, 6% in deficient male controls. Females cases as compared had 44% deficiency and 44% insufficiency and 12% in sufficiency range and Female controls had 50% sufficiency, 30% insufficiency & 20% deficiency. There was no positive correlation between sex and Vitamin D levels.

Similar were the findings in a Indian study V Wayse *et al*. [12] done in Belgaum where they could not find a relationship between Vitamin D levels and gender.

Vitamin D levels and there relation to the severity of the disease was found to be as following, in the cases with deficiency values of Vitamin D was found 29 (72.5%) in the severe pneumonia and 11 (27.5%) in the very severe pneumonia group, in the Insufficiency group we found that 30 (90.9%) were in the severe pneumonia group and 3 (9.1%) in the very severe pneumonia group, In the sufficiency group, there were 7 (100%) children who fell into the category of severe pneumonia, this finding suggested that there was a relation with the Vitamin D levels, our study findings suggested that as the vitamin D levels falls the severity of the disease also increases.

One similar findings were found in study by Brehm *et al*. [9] In which they found that as the age progress the Vitamin D levels also increases and the severity of the disease comes down. The Explanation given in this study was that as the age progresses children are more exposed

to sunlight and hence Vitamin D levels tend to increase.

Conclusion

In this study, we found that Vitamin D levels were related to severity of the disease as there were no children in the sufficiency group having very severe pneumonia.
Hence we can say as the levels of Vitamin D falls the severity of pneumonia Increases.
Further larger studies are required to compare the Vitamin D levels in normal children without any morbidity to come to a better conclusion of Vitamin D levels in children in the Indian Subcontinent.

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