

Vitamin D Status in Children with Severe Bronchopneumonia Admitted In PICU in Age Group 6 Months to 5 YearsMajeed Ali Afroz¹, Sahar Shakil Wani², Altaf Naseem³¹Assistant Professor, Dept. of Paediatrics, Nova Institute of Medical Sciences and Research Centre, Hyderabad, Telangana, India²Junior Resident, Dept. of Pathology, Dr. Patnam Mahender Reddy Institute of Medical Sciences, Telangana, India³Professor, Dept. of Paediatrics, Apollo Institute of Medical Sciences, Hyderabad, Telangana, India

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Abstract**Background and Objectives:** Childhood pneumonia accounts for significant under 5 morbidity and mortality among children. Immunomodulatory role of Vitamin D in LRTI is well established. This study is done to correlate severe pneumonia and vitamin D deficiency along with other factors.**Methods:** This study was conducted from January 1, 2018 to June 30, 2019 in PICU of a tertiary care centre. Detailed history, hemodynamic stability and lab data were collected. Patients were categorised into sufficient, insufficient and deficient status based on Vitamin D levels.**Results:** Out of 80 children with severe pneumonia, 40 were vitamin D deficient which included all the 8 patients with very severe pneumonia. 36 out of 40 patients were malnourished. 60% had history of adequate sunlight exposure. Only 1 belonged to low socioeconomic class.**Conclusion:** In our study 50% of the cases had vitamin D deficiency and was related to disease severity. Factors like sunlight exposure, sex, malnutrition and socio-economic status were not significantly associated with vitamin deficiency. Vitamin D supplementation is recommended as only 9% of the cases had sufficient levels.**Keywords:** Vitamin D; Paediatric Pneumonia; Vitamin D supplementation, Lower Respiratory Tract Infection.**DOI:** 10.25258/ijcpr.18.9.139

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Introduction

Lower respiratory tract infections (LRTI) including pneumonia constitute a major cause of morbidity and mortality in children especially in developing nations like India where they accounts for 20% of deaths [1,2]. Recent studies suggest that vitamin D has a role in lung growth, preserving lung function, and preventing pulmonary infection [3].

Apart from its role in calcium-phosphorus homeostasis, Vitamin D has been found to play a crucial role in innate immune response principally by increasing the production of antimicrobial peptides (B-defensin, cathelicidin) [4]. Vitamin D is derived from both sun exposure and dietary intake, however dietary intake does not contribute much in children given their food habits. Despite abundant sunlight in India, Vitamin D deficiency is widespread and it is necessary to determine the genetic and environmental factors which are responsible for low serum 25OHD values in India [5] A meta-analysis of eight observational studies indicated a potential association between vitamin D

deficiency and pneumonia [6]. Clinical Vitamin D deficiency (rickets) was associated with 13 fold increased risk of pneumonia in Ethiopian children under 5 years of age [7]. In Yemen, 50% of children admitted to hospital for acute lower respiratory infection (ALRI) had Vitamin D deficiency rickets [8]. This study aims to find out the relation between Vitamin D levels and severity of pneumonia.

Material and Methods

This descriptive analytical study was conducted from January 2018 to June 2019 on patients admitted to PICU with severe and very severe pneumonia at a tertiary care centre. Local Ethics Committee approval was granted. Consent was taken from the Parents. Detailed history was taken using a structured questionnaire. Routine blood investigations, chest x-ray and Vitamin D levels were sent. Patients with vitamin D levels below 20 ng/ml were considered deficient, levels between 20 to 30 ng/ml were considered insufficient and levels

more than 30 ng/ml were considered sufficient. Patients between the age group of 6 months to 5 years were included. Patients were divided into two groups according to WHO guidelines for ARI control program [9] i.e. severe pneumonia and very severe pneumonia.

Statistical Analysis: Descriptive and inferential statistical analysis were carried out. Results were presented as Mean $\pm$ SD on continuous measurements as percentiles on categorical measurements. SAS 9.1 and SPSS 16.0 were used for Statistical analysis.

Results

In this study 80 paediatric patients fulfilled the inclusion criteria. No significant difference was seen among males (52.5%) and females (27.3%) with Mean $\pm$ SD of 2.54 $\pm$ 1.41 (Table 1). IAP classification demonstrated normal nutrition in 10 patients and 39, 18, 9 and 4 patients had ranges of malnutrition from grade 1 to 4 respectively. There was no significance ($p=0.861$) difference among males (38 had malnutrition of 42) and females (32 had malnutrition of 38).

Sunlight exposure was adequate in more than half of the patients 46 (57.5%) and inadequate in 34 patients distributed amongst age groups of 6m-2 yrs ($n=21$) and 2-4 yrs ($n=13$), probably due to indwelling habits of these age groups. Sunlight exposure was slightly but insignificantly more in females($n=17$) than males($n=13$). Overall, only one patient each were in "upper" and "lower" socio economic state and remaining are distributed amongst upper middle, lower middle and upper lower with majority in the lower middle ($n=41$, 51.3%) and upper lower ($n=30$, 37.5%).

The study population was divided into 2 groups according to ARI (WHO) as severe pneumonia ($n=66$, 82.5%) and very severe pneumonia ($n=14$, 17.5%) with no gender significant distribution ($p=0.702$, Fisher exact test). Within severe pneumonia, the majority were in the age group of 2-4 years ($n=37$, 56%) followed by 6 months-2 years ($n=21$, 31.8%) with least among 4-5 years ($n=8$, 12%). In very severe pneumonia cases, majority were in the age group of 6 months-2 years ($n=8$, 57.1%) followed by 2-4 years ($n=4$, 28.5%) followed by and similar to severe pneumonia cases, age group 4-5 years ($n=2$, 14%). Chest X-ray was normal in 6 cases (3 of either sex). Among the remaining, 44 patients showed Pneumonia, 12 patients showed rickets and 18 had both Pneumonia and rickets. Vitamin D deficiency was noted in 50% of the cases ($n=40$),

insufficiency in 33 patients (41.2%) and sufficiency in 7 patients (8.8%).

More than half of the cases with vitamin D deficiency were in 2-4 years ($n=22$, 55%) followed by 6months-2 years ($n=14$, 35%) and 4-5 years ($n=4$, 10%) (Table 2). Insignificant difference was seen in gender distribution with 23 males (54.8%) and 17 patients females (44.7%). Nutritional status was normal in 4 patients and in rest of the cases it varied from grades I to IV (19, 9, 5 and 3 respectively). When malnutrition status of patients was studied against Vitamin D levels, in age group 6months-2 years ($n=20$) normal nutrition was reported in 2 cases and grades I to IV involved 11, 2, 3 and 2 patients respectively. Sunlight exposure was adequate in 27 cases (67.5%) and inadequate in 13 cases (32.5%). Of the 27 cases with adequate sunlight exposure, 6months-2 years age group had 7 patients (17.5%), 2-4 years age group had 16 cases and 4 cases were in 4-5 years age group. Patients with inadequate sunlight were amongst 6month-2 years ($n=12$, 30%) and 2-4 years ($n=1$, 2.5%). Socioeconomic status in these vitamin D deficient cases included one patient each of upper and lower and upper middle ($n=3$, 7.5%), lower middle ($n=20$, 50%) and upper lower ($n=15$, 37.5%). Severe pneumonia was seen in 32 cases (72.5%) and very severe pneumonia was seen in 8 patients (27.5%). Among severe pneumonia cases, majority were in age group 2-4 years ($n=17$, 53%) followed by 6months-2 years ($n=10$, 31%) and 4-5 years group ($n=5$, 15.6%) with no much difference in gender distribution (males = 14 and females = 18). In the very severe pneumonia cases, majority of the cases were in age group 6months-2 years ($n=5$, 62.5%) followed by 2-4 years ($n=2$, 25%) and 4-5 years group ($n=1$, 12.5%).

There are no cases of very severe pneumonia and sufficiency group (table 3). Males had majority of the deficiency (63.6%) and females accounted for 36.4%. Chest X-ray showed normal findings in 2 patients(5%), pneumonia in 18 patients (45%), rickets in 6 patients (15%) and both pneumonia and rickets in 14 patients (35%).

What This Study Adds?: Vitamin D deficiency in children has been reported to be a significant risk factor for severe acute lower respiratory tract infection owing to its influence on the host's immune system. This study aims to highlight the prevalence of Vitamin D deficiency in our population and spread awareness among healthcare facilities to provide adequate supplementation as well as dietary and lifestyle advice.

Table 1: Age and gender distribution

Age Group	Male	Female	Total
6m-2 Yrs	16 (38.1%)	13 (34.2%)	29 (36.2%)
2-4 Yrs	19 (45.2%)	22 (57.9%)	41 (51.3%)
4-5 Yrs	7 (16.7%)	3 (7.9%)	10 (12.5%)
Total	42 (100%)	38 (100%)	80 (100%)

Table 2: Vitamin D level distribution amongst age groups

Age Group	Vit D Deficiency	Vit D Insufficiency	Vit D Sufficiency	Total
6m-2 YRS	14 (35%)	13 (39.4%)	2 (28.6%)	29 (36.3%)
2-4 Yrs	22 (55%)	16 (48.5%)	3 (42.9%)	41 (51.3%)
4-5 Yrs	4 (10%)	4 (12.1%)	2 (28.6%)	10 (12.5%)
Total	40 (100%)	33 (100%)	7 (100%)	80 (100%)

Table 3: Very severe pneumonia cases age wise with Vitamin D levels

Age Group	Vit D Deficiency	Vit D Insufficiency	Vit D Sufficiency	Total
6m -2 YEARS	5(62.5%)	3(50%)	0	8(57.1%)
2-4 YEARS	2(25%)	2(33.3%)	0	4(28.5%)
4-5 YEARS	1(12.5%)	1(16.7%)	0	2(14.2%)
TOTAL	8(100%)	6(100%)	0	14(100%)

Discussion

Vitamin D deficiency is one of the most common nutritional deficiency among children in India. Vitamin D deficiency in children has been reported to be a significant risk factor for severe acute lower respiratory tract infection owing to its influence on the host's immune system, modulating both innate and adaptive immunity and regulating the inflammatory cascade.

It is shown that vitamin D induces the expression of the human cathelicidin antimicrobial peptide (CAMP) gene which is a major component of innate immunity. Vitamin D metabolites play an important role in induction of phagocyte migration, modulation of the Th1–Th2-cell balance, and the differentiation of T regulatory cells. It is surprising and disturbing to note that hypovitaminosis D is highly prevalent even in areas with adequate sunlight. The 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 [10-14].

In this study, we found 50% of cases to be deficient (n = 40) and 41.2% to be insufficient (n = 33) in Vitamin D levels. Only 8.8% had sufficient (n=7) Vitamin D levels which is far below the levels expected as India is a country with adequate sunlight. A study conducted by Kate Madden et al [15] showed similar findings were out of 511 children the median vitamin D level was 22.5 ng/mL of which 40.1% were vitamin D deficient, 46.6% were insufficient and 13.3% were sufficient in Vitamin D. In our study, the mean age was 2.57 years compared to 1.99 years in a study by V Wayse et al [10] which included severe and very severe pneumonia children in the age group 6 months to 5 years. 55% of cases with deficiency

and 48.5% with insufficiency were in the age group of 2-4 years. As concluded in their report, as the age progresses the mean Vitamin D level also increases. Male to female ratio was 1.1: 1 (42 and 38) respectively. 54% of males had Vitamin D levels in the deficiency range and 38% insufficiency and 7% in the sufficiency range. Females as compared had 44% deficiency and 44% insufficiency and 12% in sufficiency range. There was no correlation between sex and Vitamin D levels similar to a finding seen in a study conducted by V Wayse et al. in Belgaum, India.

In our study out of 80 cases, 66 had severe pneumonia of which 21 cases belonged to age group of 6 months to 2 years, 37 cases in the age group of 2 to 4 years and 8 cases in the age group of 4 to 5 years. In a descriptive study by Amrit banstola et al [11] it was noticed that 49% of pneumonia cases were found in children less than 1 year of age and 44.8% in 1-5 years of age. Very severe pneumonia was seen in 14 cases of which 8 belonged to the age group of 6 months to 2 years, 4 cases are in the age group of 2-4 years and 2 cases are in the age group 4-5 years.

Majority of the children fulfilled grade 1 (48.8%) and grade 2 (22.5%) malnutrition criteria, and 12.5% children were adequately nourished. Only 5.2 % children with grade 1 malnutrition and 16.7% with grade 2 malnutrition were sufficient in Vitamin D. A study by David R. Fraser [15] et al suggested that utilisation of available Vitamin D is impaired in malnourished bodies.

Our study suggests that Vitamin D deficiency is directly proportional to disease severity. The only limitation to our study is that it is a single centre study.

Conclusion

Despite adequate sunlight, Vitamin D deficiency is common in India. The evidence presented in this study suggests Vitamin D deficiency is directly related to severity of bronchopneumonia. However, there was no significant relation amongst sex, malnutrition and socio-economic status. Vitamin D supplementation is recommended.

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