

ORIGINAL RESEARCH

Study of Vitamin D Status in Children Aged 1 Month to 5 Years Admitted With Pneumonia in a Tertiary Care Medical Center

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ABSTRACT

Background: To determine the impact of vitamin D status on the susceptibility and severity of pneumonia in children of age 1 month to 5 years.

Materials and Methods: This case control study was conducted from September 2020 to September 2022 in children admitted to Pediatric Care Intensive Unit (PICU) Mamata Academy of Medical Sciences Hospital. Out of total 150 study participants, 75 children with new onset pneumonia were taken as cases and 75 healthy children who were matched for age and sex were taken as controls. All children with pneumonia were admitted and categorized according to Revised WHO (2014) guidelines. Serum vitamin D levels were sent. As per recent Indian Academy of Pediatrics (IAP) recommendations, Serum Vitamin D levels < 12ng/dl were taken as deficient levels, 12-20ng/dl as insufficient levels and > 20ng/dl as sufficiency level¹.

Results: Our study showed a correlation between hypovitaminosis D and pneumonia. We found that hypovitaminosis D was significantly associated with pneumonia compared to healthy controls and we also found that all cases with severe pneumonia had significantly lower vitamin D levels than healthy controls.

Conclusions: In our study, we conclude children with lower vitamin D levels are at increased risk for acquiring pneumonia and also are at increased risk of developing severe pneumonia. We conclude to consider vitamin D supplementation in children younger than 5 years to reduce the risk of acquiring pneumonia, although larger RCTs are required to support this.

Keywords: Vitamin D, hypovitaminosis, Pneumonia, Severe Pneumonia.

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INTRODUCTION

Pneumonia killed 808 694 children under the age of 5 in 2017, accounting for 15% of all deaths of children under five years old.^[2] In 2015, India, Nigeria, Indonesia, Pakistan, and China contributed to more than 54% of all global pneumonia cases with 32% of the

global burden from India alone.^[3] According to the estimates of the World Health Organization (WHO), it accounts for almost 20% of overall childhood mortality.^[4] Clinical manifestations of acute childhood pneumonia include cough, fever, breathing difficulty, and lower chest wall indrawing.^[5] The most common etiological agents responsible are bacteria and viruses (e.g. *Streptococcus pneumoniae*, *Haemophilus influenzae*, and respiratory syncytial Virus). Risk factors for acute childhood pneumonia include mixed feeding or non-breastfeeding, under nutrition, indoor air pollution, prematurity, overcrowding, and no immunization against measles.^[6] Despite advances in the management of pneumonia, there is a need for effective novel therapies.^[7] Recently, there is growing interest in use of Vitamin D in preventing childhood pneumonia and in improving the outcomes of children with pneumonia. Several studies have shown the association of Vitamin D Deficiency and increased risk of pneumonia.^[8,9]

The results of a metaanalysis showed that serum vitamin D levels in children with pneumonia were significantly lower than those in healthy control children.^[10] In a study done among Indian children, high prevalence of vitamin D deficiency is reported.^[11] Vitamin D may have a potential role in protection from acute respiratory tract infections (ARTIs) by increasing the body's production of naturally-acting antibodies and showed a correlation between vitamin D levels and incidence and severity of Lower respiratory tract infections (LRTI).^[12] Considering the high incidence of pneumonia in India, this study aimed to investigate the impact of vitamin D status on the susceptibility and severity of pneumonia in children, in a case-control study.

MATERIALS & METHODS

This study is conducted among children with pneumonia admitted in PICU, Mamata Academy of Medical sciences Hospital in the age group 1 month to 60 months for a period of 2 years from September 2020 to September 2022. After informed consent, we enrolled 75 children with pneumonia as cases and 75 children without pneumonia as controls. Children with normal neurological development, normal percentiles on growth charts, all biochemical parameters within normal ranges for age, no evidence of bacterial, viral, fungal nor parasitic ongoing infections, no evidence of antimicrobial therapies within the previous three months, no vitamin D supplementation within the previous year were included in the control group. Children of 1 month to 60 months of age admitted with new onset pneumonia were taken as cases. For each child, the following data were entered into the study database: name, age, gender, vitamin D level (25-hydroxycholecalciferol, 25- OHD), Complete blood picture, and chest X-ray. Detailed history and examination was done. Revised classification of childhood pneumonia according to WHO 2014 guidelines¹³ was taken to define and assess the severity of pneumonia. Children with bronchiolitis, bronchial asthma, tuberculosis and children with clinical rickets and children who were given Vitamin D supplementation within last 4 weeks were excluded from the study. Cases were treated as per hospital protocols. Primary outcome is to study the vitamin D status in children with pneumonia when compared to controls. Secondary outcome to investigate if there is any relation between vitamin D levels and severity of pneumonia and proportion of children with Vitamin D deficiency, insufficiency and sufficiency between cases and controls. Vitamin D level was evaluated by testing for 25-OHD. Blood samples were collected with anticoagulant from study participants, plasma was separated and measurement of plasma 25(OH) D was performed by chemiluminescence using a Fluoroskan (DiaSorin LIAISON, Stillwater, MN) with micro-whole blood, which recently received a Federal Drug Administration clearance letter (510K). Reference values for Vitamin D status classification of hypovitaminosis D deficiency, insufficiency and sufficiency were used based on the Indian Academy of Pediatrics (IAP) 2021 revised

guidelines¹. The present guidelines endorse the earlier classification for vitamin D deficiency, insufficiency, and sufficiency as serum 25-hydroxy vitamin D levels as <12 ng/mL, ≥12-20 ng/mL and >20 ng/mL, respectively.

Statistical Analysis

All results were recorded in the study database following the standards for the protection of privacy and personal information in excel and data was analysed by using graphpad prism 6.0 software. Descriptive statistics were calculated as mean, median with interquartile range (median, IQR: 25th, 75th), frequency and percentages. In bivariate analyses, differences in controls and cases, characteristics in vitamin D levels were compared using Chi-square and Kruskal-Wallis tests. Differences between 2 groups were analysed by student t-test whereas multiple groups were analysed by one way Anova test followed by post-hoc analysis. Data are expressed as mean±SEM. A p-value of less than 0.05 is considered as statistically significant.

RESULTS

A total of 150 children of which 75 are cases with new onset pneumonia and admitted in Pediatric intensive care unit in the specified time period and 75 age and sex matched controls were taken into the study.

Baseline characteristics:

Table 1: Age wise Distribution of study population

Age in months	Controls	Cases
1-12 months	24	28
13-24 months	18	22
25-36 months	17	12
37-48 months	11	6
49-60 months	5	7

[Table 1]: Mean age of population in controls is 27.32 ± 1.8 months where as in cases is 22.72 ± 1.8 months. There was no statistical significant difference between both the study groups (**p=0.0802**).

Table 2: Sex wise Distribution of Study Population

	Total	Male	Female
Controls	75/150 (50%)	39/75 (52%)	36/75 (48%)
Cases	75/150 (50%)	41/75 (54.67%)	34/75 (45.33%)

[Table 2]: Of the 75 control population, 52% were males and 48% were females. Out of 75 cases, 54.67% were males and 45.33% were females.

Table 3: Vitamin D status in control group and cases

Vitamin D status	Total Participants	Controls	Cases
Deficiency: <12 ng/mL	0/150	0/75	0/75
Insufficiency: 12-20 ng/mL	31/150 (20.67%)	6/75 (4%)	25/75 (16.67%)
Sufficiency: >20 ng/mL	119/150 (79.33%)	69/75 (46%)	50/75 (33.33%)

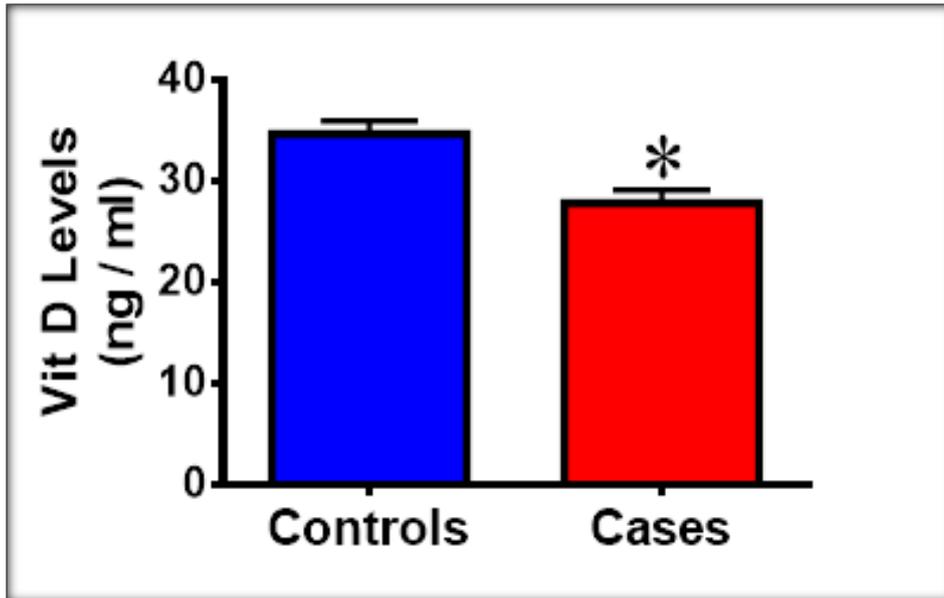


Figure 1: Vitamin D status in control group and cases

[Table 3 & Figure 1]: Mean vitamin D level of controls was 34.69 ± 1.25 ng/ml. Mean vitamin D level of cases was 27.8 ± 1.2 ng/ml. Plasma level of 25(OH) D was significantly lower in cases than controls. $p < 0.05$ was statistically significant.

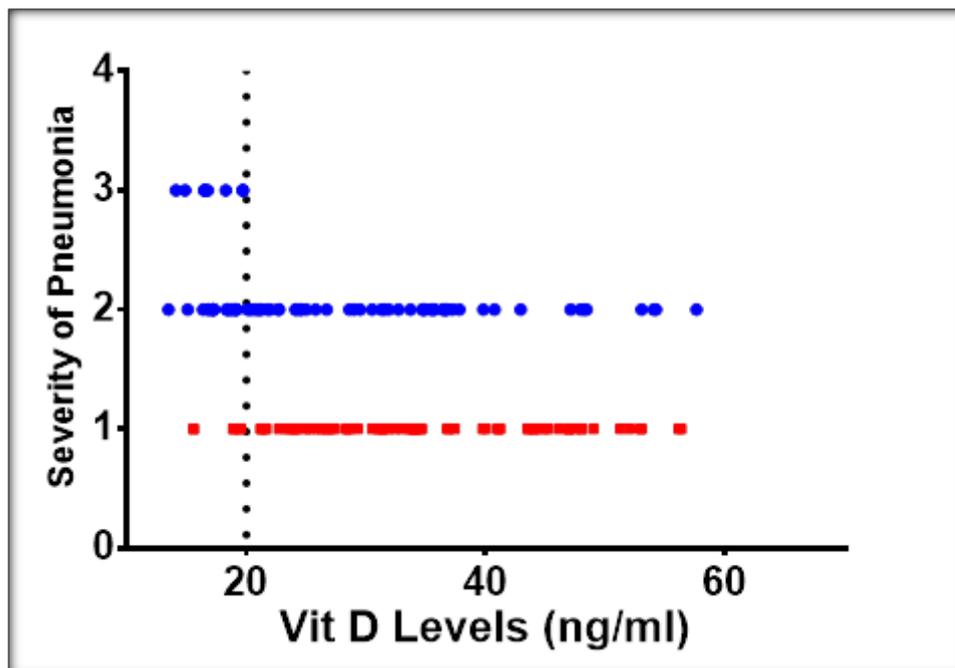


Figure 2: Correlation between vitamin D levels and severity of pneumonia

[Figure 2]: Number of cases with grade 2 (pneumonia) and grade 3 (severe Pneumonia) had significantly lower vitamin D levels than healthy controls. (P value: 0.0034)

DISCUSSION

Pneumonia is a common disease with significant morbidity and mortality. This study was undertaken with the aim to study the vitamin D status in children with pneumonia and to

investigate if there is any association between vitamin D levels and severity of pneumonia in the age group of 1 month to 5 years. In our study, hypovitaminosis-D (serum vitamin D level less than 20 ng/mL) was significantly associated with pneumonia. Overall, 21% children in our study had hypovitaminosis D. Among children with pneumonia, 33% were found to have hypovitaminosis D. In a recent study from India, done by Siddique et al,^[14] in children with pneumonia of age group 5 months to 5 years, they noted that low levels of vitamin D was associated with higher incidence of pneumonia. In a study done by Wayse et al,^[15] a total of 150 children were enrolled including 80 cases and 70 controls, aged 2-60 months and concluded that subclinical vitamin D deficiency was a significant risk factor for severe ALRI in Indian children. Karatekin et al,^[16] compared neonates admitted with ALRI in NICU to healthy neonates and found that Vitamin D levels were significantly lower in neonates with ALRI and suggested that new-borns with subclinical vitamin D deficiency may be at increased risk of suffering from ALRI. Similar to our study, in a recent study by Ren et al,^[17] it was found that mean vitamin D concentration in the group with severe pneumonia was significantly lower than that in the mild pneumonia and control groups ($p= 0.01$), and there was no significant difference between the mild pneumonia and control groups ($p = 0.674$). McNally et al,^[18] in their study noted that 50 % of the patients admitted to the Pediatric intensive care unit were vitamin D deficient compared to only 20 % on the general medical floor ($P=0.02$) suggesting that low levels of vitamin D predispose to greater acute lower respiratory infection severity.

However, there are few studies whose findings are in contrast to our findings.^[19, 20, and 21] In a recent study from India, Jat KR et al,^[22] found that although majority of children in the study were vitamin D deficient, the Vitamin D levels were not different in cases and controls and were not related to severity and outcome of pneumonia. The limitation to our study is the calculation of vitamin D in the breast milk was not done for infants and Sun exposure was not taken. Further research is needed to better correlate vitamin D status and pneumonia in children of different ages.

CONCLUSION

Our study concludes that serum vitamin D levels were significantly lower in children with pneumonia. Also, vitamin D levels are correlated with severity of pneumonia. This indicates children with lower vitamin D levels are increased risk for acquiring pneumonia and also are at increased risk of developing severe pneumonia. We conclude to consider vitamin D supplementation in children younger than 5 years to reduce the risk of acquiring pneumonia, although larger RCTs are required to support this.

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