Vitamin D Deficiency among Children Aged 1-5 Years with Severe Pneumonia in comparison to Healthy Controls

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ABSTRACT

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Background: Vitamin D Deficiency is on the rise and the effect of Vitamin D deficiency in various diseases like respiratory illness is being increasingly recognized. Hence this study was planned.

Objectives: To asses Dietary pattern, sun exposure, place of residence, Immunization status, anthropometry and Vitamin D levels among children-aged-1-5 years with severe pneumonia in comparison to healthy controls and find the association between Vitamin D deficiency and severe pneumonia.

Methods: Relevant parameters were assessed among 33 children with pneumonia and 33 healthy controls. Vitamin D was assessed using CLIA and was categorized into Normal (>30 ng/ml), Insufficient (20-19 ng/ml) and Deficient (<20 ng/ml) and both insufficient and deficient were included in low Vitamin D category. The data analyzed using SPSS version 24.

Results: Children belonged to Middle and Upper Lower Socio-Economic status. Mean age, gender, and Immunization status were comparable in both groups. 73% among cases and 49% controls were from rural setting. Malnutrition was more in the pneumonia group. Exclusive breastfeeding rate during first 6 months was lower than Kerala NFHS 5 data of 55%. Milk and Egg exclusion diet was noted in 12% and there was a significant association between exclusion diet and low Vitamin D status (P-0.015). Adequate sun exposure was noted in only 18% in the total children, 15% cases and 21% controls. 91% with adequate sun exposure had normal Vitamin D levels. The mean Vitamin D level was (34.13+ 14.01) ng/ml in cases Vs. (36.14 + 9.48) ng/ml in controls. Among the total children, 36% had low Vitamin D level and 6% were in the deficient category. Proportion of children with low Vitamin D were significantly more among cases than controls (51.5% vs 21.2%: P- 0.011).

Conclusions: Dietary pattern, sun exposure and Vitamin D levels were suboptimum among the study children. Exclusion diets and reduced sun exposure were associated with low Vitamin D levels. Those with severe pneumonia had significantly lower Vitamin D levels compared to normal control children. Hence a closer look at this public health problem is recommended in order to optimize dietary pattern, sun exposure and Vitamin D Status among children in health and diseases.

Keywords: Sun Exposure, Exclusion Diets, Vitamin D Status, Vitamin D Insufficiency, Vitamin D Deficiency, Severe Pneumonia

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INTRODUCTION & RATIONALE

Currently vitamin D Deficiency is on the increase and is now recognized as a Lifestyle related disease. The skeletal and extra-skeletal manifestations of Vitamin D deficiency and excess are important public health challenges.[1] Vitamin D sufficiency is recommended for prevention of various diseases, including respiratory diseases. Frequent respiratory infections are common among under-five children. Hence, this study was undertaken.

This research paper investigates the factors associated with Vitamin D deficiency and the association between Vitamin D deficiency and severe pneumonia in children aged 1-5 years. Vitamin D is the most under diagnosed and untreated deficiency. This utilizes a sample size of 33 cases and 33 controls based on a study by Li W et al.[2] Vitamin D status is categorized as deficiency (<20 ng/ml), insufficiency (21-29 ng/ml), and normal (30-80 ng/ml), with serum 25 (OH) vitamin D measured by CLIA.[3] Pneumonia is considered as the leading cause of under 5 mortality in the world.[4] Severe pneumonia

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Table 1. Baseline Parameters in the Study Population

Sl. No	Parameter		Cases n (%)	Controls n (%)	P Value
1	Gender	(M)	23 (69.7%)	20 (60.6%)	0.438
		(F)	10 (30.3%)	13 (39.4%)	
2	Place of residence	Rural	24 (72.7%)	16 (48.5%)	0.044*
		Urban	9 (27.3%)	17 (51.5%)	
3	Exclusive breast feeding	<6 months	19 (57.6%)	21 (63.6%)	0.614
		Till 6 months	14 (42.4%)	12 (36.4%)	
4	Vitamin D supplementation till 1 year of age	Yes	14 (42.4%)	16 (48.5%)	0.621
		No	19 (57.6%)	17 (51.5%)	
5	Exclusion diet (Egg/ Milk)	No	27 (81.8%)	31 (93.9%)	0.23
		Yes	6 (18.2%)	2 (6.1%)	
6	Sunlight exposure	<1 hour/ day	28 (%84.8)	26 (78.8%)	0.523
		>1 hour/ day	5 (15.2%)	7 (21.2%)	
7	Immunization- Fully Immunized for age		33 (100%)	33 (100%)	

is defined as fever, cough along with danger signs or stridor in a calm child (WHO Classification).

OBJECTIVES

1. To assess dietary pattern, sun exposure, place of residence, anthropometry and Vitamin D levels using CLIA in children aged 1-5-years with severe pneumonia in comparison with an age and sex-matched healthy control group.
2. To find the association between Vitamin D deficiency and severity of pneumonia.

METHODOLOGY

The sample size was calculated based on study by Li W et al,[2] aiming to explore the relationship between vitamin D levels and severe pneumonia in children aged 1-5 years. Relevant parameters were assessed among 33 children with pneumonia and 33 healthy controls, selected by Non-Random sampling, enrolling consecutive cases and controls. Detailed clinical history and investigation reports were recorded using a standardized proforma. Vitamin D was assessed using CLIA and was categorized into Normal (>30 ng/ml), Insufficient (20-19 ng/ml) and Deficient (<20 ng/ml). Both insufficient and deficient were included in low Vitamin D category. This study was conducted over 20 months in the Tertiary Care Centre in Kerala. Nutritional status was evaluated using anthropometric measurements, including weight-for-age, height-for-age, and weight-for-height. Dietary patterns were assessed using food frequency questionnaires. Sun exposure and outdoor activities were also documented.

Table 2. Vitamin D Status in relation to Sun Exposure in the Study

Sl. No	Sunlight exposure	S. Vitamin D level		P Value
		Low n (%)	Normal n (%)	
1	<1 hour/day	23 (95.8%)	31 (73.8%)	0.026*
2	>1 hour/day	1 (4.2%)	11 (26.2%)	
3	Total	24 (100%)	42 (100%)	

Quantitative Variables were expressed as mean and standard deviation. Qualitative variables were expressed as frequency and percentage. Comparison of continuous variable between two group were analysed by student t test. Association between qualitative variables were analysed by Chi square test. A p- value <0.05 was considered statistically significant. Data was analysed using SPSS version 24.

RESULTS

The children belonged to Middle and Upper Lower Socio-Economic status. 73% among cases and 49% controls were from rural setting. Mean age, gender, and Immunization status were comparable in both groups. The Mean age of cases and controls in our study was (2.7 years ± 1.1) and (3.3 years ± 1.2) respectively. Male to Female ratio was 23:10 in cases and 20:13 in controls. Entire study population was fully immunized for age (100%) according to National Immunization schedule. In this study, 42.4% of cases and 36.4% of controls were on exclusive breast feeding during first 6 months. Malnutrition was more in the pneumonia group. Breast-feeding rate was less than the NFHS - 5 FACT SHEET Kerala data,[5] where 55.5% were exclusively breast fed. Exclusion of Milk and Egg in the diet was noted in 12% and there was a significant association between exclusion diet and low Vitamin D status (P-0.015). The baseline parameters in the study are summarised in **table 1**. Both cases and controls lacked adequate sun exposure. Only 15.2% among cases and 21.2% among controls had exposure of >1 hour/day. This was not statistically significant. Adequate sun exposure was noted in only 18% in the total children. 91% with

Table 3. Vitamin D Status among Cases and Controls in the Study

Sl. No	Vitamin D status	Case n (%)	Control n (%)	Total n (%)	P Value
1	Total	17 (51.5%)	7(21.2%)	24 (36.4%)	
2	<1 hour/day	16 (48.5%)	26 (78.8%)	42 (63.6%)	0.011*
3	Total	33 (100%)	33 (100%)	66 (100%)	

adequate sun exposure had normal Vitamin D levels **(Table 2).** Mean Vitamin D level was (34.13±14.01) ng/ml in cases Vs. (36.14 ± 9.48) ng/ml in controls. Among the total children, 36% had low Vitamin D level and 6% were in the deficient category. Proportion of children with low Vitamin D were significantly more among cases than controls (51.5% vs. 21.2%: P- 0.011). Vitamin D status among cases and controls is depicted in **Table 3.**

DISCUSSION

The sample size of 33 cases and 33 controls ensured a robust analysis. Exclusion diet and inadequate sun exposure are important causes for vitamin D deficiency. In Kerala as per Comprehensive National Nutrition Survey - CNNS 2016-2018[6] among 2-4 years 40.7% children were excluding dairy products and 53% were excluding egg from their diet, which is more than what was observed in the study. Gordon CM et al[7] in his study on Prevalence of Vitamin D deficiency among healthy adolescents found out that 4.6% children were Vitamin D deficient and 42 % had low vitamin D level, compared to 6% and 36% respectively in this study. The findings of the study conducted by Garg D et al[8] reported statistically significant difference between cases with pneumonia and controls, with respect to vitamin D deficiency and insufficiency, which is in accordance with this study. In their study, 47.5% cases showed low vitamin D compared to 22.5 % controls. There are clinical and molecular evidences that vitamin D supplementation reduces the rate of respiratory tract infections.[9,10,11] In a previous study from the same region, association between Vitamin D deficiency and severity of pneumonia among children has been reported.[12]

CONCLUSION

Vitamin D insufficiency and deficiency was significantly more in those with severe pneumonia, compared to controls. Inadequate sunlight exposure, lack of Vitamin D rich food (egg/milk) in diet were associated with low Vitamin D levels. Adequate sunlight exposure and inclusion of Vitamin D rich diet should be encouraged. The findings of the study recommend targeted public health interventions addressing vitamin D deficiency and its potential impact on respiratory health.

LIMITATIONS

Only a larger sample size can increase generalizability of the study. Effect of confounders like air pollution, nutritional sufficiency was not included in the study.

END NOTES

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