

Original Research Article

## Nutritional Factors and Vitamin D Status in Relation to Severity of Pneumonia among Children

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### ABSTRACT

**Objective:** To compare nutritional factors like Infant & Young Child Feeding (IYCF) practices, nutritional status and serum vitamin D levels with severity of pneumonia among 1-5-year-old children.

**Methods:** Children admitted with severe and very severe pneumonia, as per IMNCI guidelines were enrolled. Their nutritional status including IYCF practices and serum 25-hydroxy vitamin D levels were compared.

**Results:** Out of 78 children, 40 (51%) had severe and 38 (49%) had very severe pneumonia. Socio-demographic factors and nutritional status were comparable in the two groups ( $P>0.05$ ). Majority, 22/34 (65%) with non-exclusive breastfeeding for 6 months, 7/9 (78%) with duration of breastfeeding <4 months of age and 26/37 (70%) among those with previous admission for pneumonia had very severe pneumonia ( $P < 0.05$ ). Vitamin D was suboptimum or deficient in 37 (48%). 25/37 (68%) in this category had very severe pneumonia ( $P < 0.01$ ); 10/11 in the deficient, 6/6 in the severely deficient and 3/3 in the very severely deficient group had very severe pneumonia ( $P < 0.001$ ). 34/37 (92%) with previous history of pneumonia were in the deficient group ( $P < 0.001$ ).

**Conclusion:** Very severe pneumonia was significantly more in those with non-exclusive breastfeeding for 6 months, duration of breastfeeding <4 months of age, previous admission with pneumonia and vitamin D deficiency. Very severe pneumonia was more in those with more severe vitamin D deficiency. Nutritional aspects like IYCF practices and vitamin D status being modifiable factors, the results of the study are of utmost public health importance.

**Key Words:** Severity of Pneumonia, IYCF practices, Nutritional status, Vitamin D Deficiency

### INTRODUCTION

Pneumonia is the most common killer disease among children. Nutritional factors like Infant & Young Child Feeding (IYCF) practices and nutritional status influence the occurrence and outcome in community acquired pneumonia (CAP). The anti-rachitic or sunshine factor, vitamin D is now considered as a steroid hormone that regulates genomic functions like regulation of cell growth, cell differentiation and immune function in addition to bone health.

The extra skeletal effects and the universal presence of vitamin D receptors have been highlighted.<sup>(1)</sup> The change in lifestyle, dressing habits, lack of sun exposure and environmental pollution has resulted in higher prevalence of vitamin D deficiency. It has also been linked to respiratory infections such as pneumonia, tuberculosis, bronchiolitis and asthma.<sup>(2)</sup> This study was undertaken to assess nutritional factors and vitamin D status in relation to severity of pneumonia among children.

## METHODS

Participants consisted of 78 children in the age group, 1-5 years of age; 40 with severe and 38 with very severe pneumonia. Sample size was calculated as 78, based on the formula  $(Z\alpha)2\times SD^2 / d^2$ . Consecutive cases, with severe and very severe pneumonia, as per IMNCI guidelines,<sup>(3)</sup> admitted in a tertiary care teaching hospital were enrolled. Institutional Ethics Committee approval and informed consent from the parents were obtained prior to enrolment. Those on vitamin D supplements, having rickets or other comorbidities like renal and liver diseases and those on anticonvulsant and antitubercular therapy were excluded from the study. Socio-demographic factors, IYCF practices, nutritional status and serum 25-hydroxy vitamin D levels were assessed. Dietary intake of vitamin D and extent of sun exposure were not assessed. Nutritional status was assessed using the WHO growth charts.<sup>(4)</sup> The 25-OH-Vitamin-D-ELISA, 96-welled kit, manufactured by Biovendor research and diagnostics Products, Hamburg, Germany (Cat No. REA 300/96), using monoclonal anti-25-OH Vitamin D antibody was used. Serum 25-hydroxy vitamin D levels were categorized as: > 30 - optimum/sufficiency, 20-30 - suboptimum/insufficiency, 10-20 - deficiency, 5-10 - severe and < 5 ng/ml - very severe deficiency.<sup>(5)</sup>

Data collected using structured Performa was managed using MS Excel software and analyzed using SPSS version 17.0 for Windows. Descriptive statistics was used for participant characteristics and Fisher's exact and Chi square tests were used for proportions.

## RESULTS

Out of the 78 children, 40 (51%) had severe and 38 (49%) had very severe pneumonia. The male to female ratio was 49%:51%. 43 (55%) were in the age group 1-3 years and the rest were 3-5 years old. Socio-demographic variables like age, gender, maternal education, maternal

employment, place of residence, housing conditions, place of residence and socio-economic status were comparable in the two groups with severe and very severe pneumonia ( $P > 0.05$ ). All of them belonged to middle and lower class. Only 44 (56%) of them had exclusive breastfeeding till six months of age and 9 (11.5%) had breastfeeding only for 4 months. Majority, 22/ 34 (65%) with non-exclusive breastfeeding for 6 months ( $P < 0.05$ ) and 7/9 (78%) with duration of breastfeeding <4 months of age had very severe pneumonia ( $P < 0.01$ ). Significant protective nature of exclusive breast feeding for six months against very severe pneumonia was noted ( $P < 0.01$ ;  $\chi^2 = 6.167$ ).

33 (42%) were underweight, 21 (27%) had stunting and 37 (46%) had wasting and 3 children (4%) were severely underweight with severe wasting and 1 (1.2%) had severe stunting. Nutritional status was comparable in the two groups ( $P > 0.05$ ).

**Table 1. Mean Vitamin D Level (SD) in the Two Subgroups**

Category	No. (%)	Mean Vitamin D Level- ng/ml (SD)
Severe Pneumonia	40 (51)	36.02 (10.8)
Very Severe Pneumonia	38 (49)	22.83 (13.6)
Combined	78 (100)	29.6 (13.9)

Vitamin D was suboptimum or deficient in 37 (48%). The levels ranged between 2-70 ng/ml with a mean of  $36.02 \pm 10.8$  in severe and  $22.83 \pm 13.6$  ng/ml in the very severe group. The mean serum 25 hydroxy Vitamin D levels (SD) are given in Table 1. The median (Inter Quartile Range-IPR) vitamin D levels in the two subgroups are depicted in fig 1. 25/37 (68%) in the deficient/suboptimum category had very severe pneumonia ( $P < 0.01$ ,  $\chi^2 = 10.01$ ). Very severe pneumonia was more in those who had more vitamin D deficiency; 10/11 in deficient, 6/6 in the severely deficient and 3/3 in the very severely deficient group had very severe pneumonia ( $P < 0.001$ ). None of the socio-demographic variables had any association with vitamin D deficiency ( $P$

>0.05). Table 2 summarizes the proportion of children with vitamin D sufficiency and deficiency in the two subgroups.

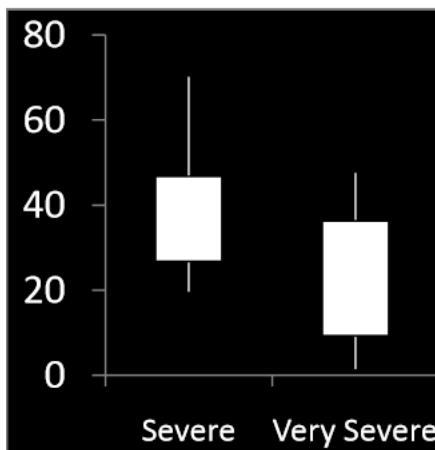
37 (47%) gave a previous history of admission for pneumonia. 26/37 (70%) among those with previous admission for

pneumonia had very severe pneumonia ( $P < 0.05$ ). Majority, 34/37 (92%) with previous history of pneumonia were in the vitamin D deficient group ( $P < 0.001$  ( $P < 0.0001$ ;  $\chi^2 = 55.79$ ).

**Table 2. Proportion of Children with Vitamin D Sufficiency and Deficiency in the Two Subgroups.**

Vitamin D Status	Severe Pneumonia	Very Severe Pneumonia	Total No.	Percentage
	No. (%)	No (%)		
Optimum > 30ng/ml	28 (70)	13 34.2	41	52.6
Suboptimum 20-30ng/ml	11 (27.5)	6 (15.79)	17	21.79
Deficiency 10-20 ng/ml	1 (2.5)	10* (26.32)	11	14.1
Severe Deficiency 5-10 ng/ml	0	6* (15.79)	6	7.7
Very Severe Deficiency <5 ng/ml	0	3* (7.89)	3	3.8
Total	40 (100)	38 (100)	78	100

\*  $P < 0.001$  Significant



**Fig. 1** Median (Inter Quartile Range) Vitamin D levels with minimum and maximum values in children with Severe and Very Severe Pneumonia

## DISCUSSION

In the present study, socio-demographic variables like age, gender, maternal education, maternal employment, place of residence, housing conditions, place of residence and socio-economic status were comparable in those with severe and very severe pneumonia. All of them belonged to middle and lower class, representing the class of people attending the public sector for medical care. Factors like maternal education, family income and availability of medical care have been attributed as risk factors for CAP. (6) The Pneumonia Etiology Research for Child

Health (PERCH) Study had found gross variability in these factors depending up on the location of study. (7)

Nutritional status was comparable in the two groups and only three children had severe wasting and one had severe stunting. High mortality has been reported in those with severe malnutrition. (8) The state of Kerala has been acknowledged as a high performing state with steady decline in child malnutrition and mortality rates. (9) IYCF practices like non-exclusive breastfeeding for 6 months and duration of breastfeeding <4 months of age were associated with very severe pneumonia. The protective role of breastfeeding has been amply highlighted by earlier workers. (10) A study had reported that subclinical vitamin D deficiency and nonexclusive breastfeeding in the first 4 months of life were significant risk factors for severe acute lower respiratory infection in Indian children. (11)

Very severe pneumonia was more in the vitamin D deficient/suboptimum category and severity was more with more severe deficiency. These observations are in accordance with other reported studies. (11,12) A similar study reported a mean level of  $34.8 \pm 15.6$  ng/ml in severe pneumonia and  $19.6 \pm 9.8$  ng/ml in very severe group

compared to  $36.02 \pm 10.8$  in severe and  $22.83 \pm 13.6$  g/ml in the very severe group in the present study. (13) It has been shown that after adjusting for demographic factors, clinical data, and season, 25(OH)D levels  $<30$  ng/ml were associated with 56% higher odds of CAP compared to levels  $\geq 30$  ng/ml (14). Significant increase in occurrence of severe CAP in children with vitamin D levels  $<20$  ng/ml has been reported. (15) Various case control trials have shown positive impact of vitamin D supplementation on the outcome of children with respiratory diseases. (16-18)

47% gave a history of previous admission for pneumonia, comparable to another study that showed previous history of pneumonia in 41%. (19) It was interesting to note that the proportion was strikingly more in the vitamin D deficient group, up to 92%. The study highlights that optimizing IYCF practices and addressing severe vitamin D deficiency in children can help to reduce morbidity and mortality in pneumonia, which is a major killer disease in children. (20)

## CONCLUSION

Non-exclusive breastfeeding for 6 months, duration of breastfeeding  $<4$  months of age, previous admission for pneumonia and vitamin D deficiency as well as severity of deficiency were related to severity of pneumonia, which is a major killer disease in children. Previous admission for pneumonia was also more in those with vitamin D deficiency. Nutritional aspects including vitamin D status being modifiable factors, the results are reported due to its public health importance.

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**Contributors:** PPS collected and analyzed the data. EKE conceived the idea, supervised the study and drafted the paper.

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