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Vitamin A Deficiency in Children Age 2 Months to 5 Years with Pneumonia Admitted at Lady Reading Hospital Peshawar

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ABSTRACT

Background: Childhood pneumonia is major cause of illness and death in children under five years, especially in developing countries, and micronutrient deficiencies like vitamin A may worsen disease severity and outcomes. **Objective:** To determine the frequency of vitamin A deficiency in children aged 2 months to 5 years presenting with pneumonia. **Study Design:** Cross sectional study. **Duration and Place of Study:** This study was carried out from 10 July 2024 to 10 January 2025 in the Department of Paediatrics, Lady Reading Hospital, Peshawar. **Methodology:** A total of 119 children aged 2 months to 5 years with pneumonia were included. Data regarding demographics and clinical features was recorded. Blood samples were collected and serum retinol level less than 0.70 µmol/L was taken as vitamin A deficiency. Data was analysed using SPSS version 26. **Results:** The mean age was 2.49±1.33 years and mean weight was 13.04±4.63 kg. Male children were 69 (58.0%) and females 50 (42.0%). Vitamin A deficiency was found in 64 (53.8%) children. Higher deficiency was seen in poor socioeconomic group 39 (75.0%) compared to high group 9 (30.0%) (p<0.001). Children with uneducated 16 (66.7%) and primary educated parents 26 (68.4%) showed higher deficiency (p=0.013). **Conclusion:** Vitamin A deficiency is highly prevalent in children with pneumonia and significantly associated with poor socioeconomic status, low parental education, rural residence and household smoking.

INTRODUCTION

Childhood pneumonia is a common and critical condition in the category of lung infection mainly affecting children below five years of age, especially in less developed nations.[1] There are different types of microorganisms which are responsible for the condition including bacteria, viruses, and sometimes even fungi, whereby bacteria such as the pneumococcus (Streptococcus pneumoniae) and viruses like the respiratory syncytial virus have been known to cause the condition.[2] Clinically, patients suffer from conditions such as coughing, high body temperature, dyspnea, chest indrawing, cyanosis, while in small children the signs and symptoms can be quite vague including irritability and lethargy.[3]

Deficiency of vitamin among children is an important issue that affects the public sector in areas where there are not enough resources and inadequate nutrition.[4] The lack of vitamins may cause reduced immunity in the body, thus making children prone to diseases like pneumonia due to their inability to fight infections.[5] Vitamins A, D, C, and E are important in ensuring adequate immune strength and the well-being of the epithelium.[6] Vitamin deficiency causes growth impairment, poor development, and increased chances of contracting infections. Poor nutrition and infections create a vicious cycle where deficiency leads to infections, which worsen nutrition.[7]

The deficiency of vitamin A is one of the important micronutrient deficiencies that occur among children below five years old.[8] It is known that such a problem correlates with an increased probability and severity of diseases, including pneumonia. Vitamin A is necessary for the proper functioning of epithelial tissue, immunity, and eyesight.[9] The lack of this element leads to xerophthalmia, night blindness, and even permanent blindness in the most extreme cases. In the case of pneumonia, it may lead to the weakening of the epithelial layer of the lungs and the immune system's response to pathogens, thus increasing the likelihood of developing pneumonia.[10]

This research is justified since pneumonia still persists as a major disease burden among children below the age of five years, especially in developing countries where malnutrition issues are common. Vitamin A deficiency can worsen the disease burden; yet, the magnitude of vitamin A deficiency among affected children is not well understood in many communities. Information about the burden of vitamin A deficiency among children aged

between two months and five years old who have pneumonia is not available in many localities. The objective of this study is to determine the prevalence of vitamin A deficiency in children age 2 months to 5 years with pneumonia.

METHODOLOGY

This cross sectional study was carried out in the Department of Pediatrics at Lady Reading Hospital over a period from 10th July 2024 to 10th January 2025. Ethical approval was obtained from the institutional ethical review committee as well as from College of Physicians and Surgeons Pakistan prior to initiation of the study, with ethical certificate Ref No. 199/LRH/MTI dated 24/06/2024. The total sample size was 119, which was calculated by using WHO sample size software with 95% confidence level, 7% margin of error, and expected prevalence of vitamin A deficiency 18.6% in children aged 2 months to 5 years suffering from pneumonia.[11]

Inclusion Criteria

Children aged 2 months to 5 years, both genders, and diagnosed cases of pneumonia as defined in study.

Exclusion Criteria

History of cystic fibrosis, chronic cough, recent vitamin A supplementation, allergy to vitamin A or its derivatives, low birth weight, organ transplantation or immunosuppressive therapy.

After taking informed consent from parents or guardians, ensuring confidentiality and explaining that there was no harm to patient, data collection was started. Demographic details were recorded including age, gender, weight, parent socioeconomic status, education level, residential status, home smoking and duration of complaints. Detailed history and clinical examination was done for each patient including assessment of fever, respiratory rate and radiological findings. Blood sample collection was performed by taking three drops of blood from middle finger using disposable lancet, which was then placed on pre-marked filter paper circles. The samples were then dried in room temperature air for four hours before storing them in a dark place to reduce vitamin A loss. The samples were then placed in plastic packets and delivered to the hospital laboratory. The whole procedure was done by a duty doctor under the guidance of a consultant paediatrician with over three years of experience after fellowship training. After all the steps had been completed, the levels of vitamin A in the collected samples were determined. If the level of serum retinol was less than 0.70 µmol/L, it indicated vitamin A deficiency.

All collected data was entered and analysed using SPSS version 26. Quantitative variables such as age, duration of complaints and weight were expressed as mean ± standard deviation or median with interquartile range depending on distribution and Shapiro-Wilk test was applied to check normality. Categorical variables including gender, parent socioeconomic status, education level, residential status, home smoking and vitamin A deficiency were presented as frequencies and percentages. Stratification of vitamin A deficiency was done with respect to age, gender, weight, parent socioeconomic status, education level, residential status, home smoking and duration of complaints. Post stratification chi square test or Fisher exact test was applied and p value ≤0.05 was taken as statistically significant.

RESULTS

A total of 119 children aged 2 months to 5 years with pneumonia were enrolled in the study. The mean age of the study participants was 2.49 ± 1.33 years, with a mean weight of 13.04 ± 4.63 kg and a mean illness duration of 7.45 ± 3.81 days. The majority of the children were male, accounting for 69 (58.0%) of the total sample, whilst female children comprised 50 (42.0%). With regard to socioeconomic status, the largest proportion of the participants belonged to the poor category, constituting 52 (43.7%), followed by middle-class families at 37 (31.1%), and high socioeconomic group at 30 (25.2%). In terms of parental education, uneducated parents were observed in 24 (20.2%) cases, primary level education in 38 (31.9%), secondary in 35 (29.4%), and higher education in 22 (18.5%). With respect to place of residence, 50 (42.0%) children resided in rural areas and 69 (58.0%) in urban settings. Home smoking was reported in 43 (36.1%) of the households (Table-I).

Table I

Patient Demographics (n=119)

Demographics	Mean ± SD / n (%)
Age (years)	2.49 ± 1.33
Weight (kg)	13.04 ± 4.63
Duration (days)	7.45 ± 3.81
Gender	
Male n (%)	69 (58.0%)
Female n (%)	50 (42.0%)
Socioeconomic Status (SES)	
Poor n (%)	52 (43.7%)
Middle n (%)	37 (31.1%)
High n (%)	30 (25.2%)
Education	
Uneducated n (%)	24 (20.2%)
Primary n (%)	38 (31.9%)
Secondary n (%)	35 (29.4%)
Higher n (%)	22 (18.5%)
Residence	
Rural n (%)	50 (42.0%)
Urban n (%)	69 (58.0%)
Home Smoking	
Yes n (%)	43 (36.1%)
No n (%)	76 (63.9%)

With regard to the frequency of vitamin A deficiency, out of the total 119 children included in the study, 64 (53.80%) were found to be vitamin A deficient, whilst 55 (46.20%) had no deficiency, suggesting that more than half of the children with pneumonia were suffering from vitamin A deficiency (Table-II).

Table II

Frequency of Vitamin A Deficiency Among Children with Pneumonia (n=119)

Vitamin A Deficiency	Frequency	% age
Yes	64	53.80%
No	55	46.20%
Total	119	100%

On stratified analysis, socioeconomic status was found to be significantly associated with vitamin A deficiency, whereby deficiency was most prevalent amongst children

from poor families at 39 (75.0%), as compared to middle-class at 16 (43.2%) and high socioeconomic group at 9 (30.0%), with p-value <0.001. Parental education also showed a statistically significant association, with highest deficiency rates observed in children of primary-educated parents at 26 (68.4%) and uneducated parents at 16 (66.7%), compared to secondary-educated at 12 (34.3%) and higher-educated at 10 (45.5%), with p=0.013. Rural residence was significantly associated with greater vitamin A deficiency, as 36 (72.0%) of rural children were deficient compared to only 28 (40.6%) of urban children, p<0.001. Similarly, home smoking demonstrated a significant association, with 30 (69.8%) of children from smoking households being deficient versus 34 (44.7%) from non-smoking households, p=0.009 (Table-III).

Table III

Association of Vitamin A Deficiency with Demographic Factors

Demographic Factors	Vitamin A Deficiency		p-value
	Yes n(%)	No n(%)	
Age Group (years)			
≤3	46 (57.5%)	34 (42.5%)	0.244
>3	18 (46.2%)	21 (53.8%)	
Gender			
Male	37 (53.6%)	32 (46.4%)	0.968
Female	27 (54.0%)	23 (46.0%)	
Weight Group (kg)			
≤15	44 (55.7%)	35 (44.3%)	0.556
>15	20 (50.0%)	20 (50.0%)	
Socioeconomic Status			
Poor	39 (75.0%)	13 (25.0%)	
Middle	16 (43.2%)	21 (56.8%)	<0.001
High	9 (30.0%)	21 (70.0%)	
Education			
Uneducated	16 (66.7%)	8 (33.3%)	
Primary	26 (68.4%)	12 (31.6%)	
Secondary	12 (34.3%)	23 (65.7%)	0.013
Higher	10 (45.5%)	12 (54.5%)	
Residence			
Rural	36 (72.0%)	14 (28.0%)	<0.001
Urban	28 (40.6%)	41 (59.4%)	
Duration Group (days)			
≤7	29 (46.0%)	34 (54.0%)	0.072
>7	35 (62.5%)	21 (37.5%)	
Home Smoking			
Yes	30 (69.8%)	13 (30.2%)	0.009
No	34 (44.7%)	42 (55.3%)	

DISCUSSION

The current study clearly shows a high prevalence of vitamin A deficiency in this particular age group, consistent with findings in earlier research conducted on developing countries. This is evident since a total of 64 children (53.8%) have been found to suffer from vitamin A deficiency. This is partly due to vitamin A being fat-soluble and its deficiency having a close relationship with poor dietary habits, insufficient breastfeeding, and infections that cause depletion of vitamin A body stores. Pneumonia is a condition that worsens vitamin A deficiency due to the impairment of body immunity and increased metabolism. The variable of socio-economic status revealed a statistically very strong association with vitamin A deficiency (p<0.001), which means that the highest number of children suffering from vitamin A deficiency were from low socio-economic status (39 children, 75.0%) than those from relatively high socio-economic status (9 children, 30.0%).

The prevalence of vitamin A deficiency was found to be 64 (53.8%) in children with pneumonia aged 2 months to 5 years. This finding is quite comparable to the results reported by Xing *et al.*[12] who found vitamin A deficiency in 85% of children under 6 years with severe Mycoplasma pneumoniae pneumonia, which is somewhat higher than present study, possibly because their study was limited to severe cases only. Similarly, Arlappa *et al.*[13] reported a prevalence of 37% in Pakistani children under five, which is slightly lower than what was found in present study, and this difference may be because that study was a narrative review based on national survey data rather than a hospital-based population with active infection. Fidancı *et al.*[14] also reported significantly lower vitamin A levels in children with lower respiratory tract infections as compared to controls (p=0.001), which is in agreement with the present findings and further support the association between vitamin A deficiency and respiratory infections. The relatively high prevalence observed in present study can be explained by the fact that acute infections like pneumonia increase the utilisation and urinary loss of vitamin A, and also impair its hepatic mobilisation, which altogether worsen the deficiency status during illness.

Socioeconomic status was showing a highly significant association with vitamin A deficiency (p<0.001), with deficiency being most prevalent in poor families 39 (75.0%) as compared to high socioeconomic group 9 (30.0%). This is biologically plausible as poverty limits the access to vitamin A rich diet and nutritional supplementation. Imdad *et al.*[15] and Mayo-Wilson *et al.*[16] both demonstrated that vitamin A supplementation significantly reduce all-cause mortality by 24% (RR=0.76) and diarrhoea mortality by 28% in children from resource-poor settings, which indirectly reflect that economically deprived children are more vulnerable to vitamin A deficiency and its complications. Riaz *et al.*[17] also found significantly better treatment outcomes in vitamin A supplemented children with acute lower respiratory infections (85%) as compared to placebo group (69%), p=0.007, which further support the importance of addressing deficiency especially in poor socioeconomic groups.

Parental education was found to be significantly associated with vitamin A deficiency (p=0.013), with highest deficiency rates in children of uneducated 16 (66.7%) and primary-educated parents 26 (68.4%). Low maternal education is a well recognised determinant of child nutritional status as it adversely affect feeding practices and health seeking behaviour. Gultom *et al.*[18] reported that inadequate vitamin A intake was associated with increased pneumonia risk, and although their association was statistically non-significant (p=1.000), the trend was consistent with the observation that nutritional knowledge and supplementation uptake is lower in less educated families.

Rural residence was significantly associated with vitamin A deficiency, as 36 (72.0%) of rural children were deficient compared to 28 (40.6%) of urban children (p<0.001). This is consistent with the general pattern seen

in developing countries where rural areas has limited food diversity and poor access to supplementation programmes. Arlappa *et al.*[13] reported high prevalence of vitamin A deficiency across South Asia and Africa, particularly in countries like Afghanistan (49.3%) and Pakistan (37%), and attributed it largely to geographic and economic barriers in rural and underserved populations, which is in line with present findings.

Home smoking was significantly associated with vitamin A deficiency, with 30 (69.8%) of children from smoking households being deficient as compared to 34 (44.7%) from non-smoking households (p=0.009). Cigarette smoke is known to increase oxidative stress and impair micronutrient absorption and metabolism. Korutla *et al.*[19] found significant association between vitamin A deficiency and recurrent lower respiratory tract infections (p=0.02), and although smoking was not specifically analysed in that study, the biological mechanism of impaired micronutrient utilisation in the presence of environmental pollutants can partly explain the higher deficiency rates seen in children exposed to household smoke.

There are certain limitations associated with the current study that need to be kept in mind while analyzing its results. The first limitation is that the current study was a hospital-based one-center study, which restricts the generalizability of results to the general population. The second limitation is the small sample size (n=119). The third limitation is that there was no assessment of vitamin A intake through diet in the subjects.

CONCLUSION

The findings indicate that there is very high vitamin A deficiency in children with pneumonia between the ages of 2 months and 5 years. There is a strong link between socioeconomic status, parental education, living in a rural area, and smoking at home with vitamin A deficiency.

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