

Correlation between Infantile Vitamin D Insufficiency and the Incidence of Acute Lower Respiratory Tract Infections

QURATULAIN¹, BAKHTIAR AHMED BHANBHRO², ASIF ALI KHUHRO³, SONIA SALEEM⁴, BISMAL MEMON⁵, AMANULLAH LAIL⁶

¹Principal Investigator Pediatrics, unit 1 Civil Hospital Karachi Pakistan

²Associate Professor of Pediatrics, Pir Syed Abdul Qadir Shah Jilani Institute of Medical Sciences / Gambat Medical College District Khairpur mir's Sindh Pakistan

³Associate Professor of Pediatrics, Assistant Professor Pediatrics, Associate Professor of Pediatrics, Pir Syed Abdul Qadir Shah Jilani Institute of Medical Sciences / Gambat Medical College District Khairpur mir's Sindh Pakistan

⁴Assistant Professor of Pediatrics, Al-Aleem Medical College, Ghulab Devi Teaching Hospital Lahore Pakistan

⁵Graduate, Isra University Hyderabad Pakistan

⁶Assistant Professor Pediatrics, DMC/DUHS Civil Hospital Karachi Pakistan

Corresponding author: Quratulain, Email: annyayaz82@gmail.com

ABSTRACT

Background: The deficiency of Vitamin D is a common nutritional problem that is often overlooked. However, increasing evidence shows that vitamin D has a vital role in building immunity and protecting against respiratory tract infections. The researchers found that people with lower serum vitamin D levels had a higher chance of experiencing severe respiratory tract infections. It is suggested that a deficiency of vitamin D may be a risk factor for severe respiratory tract infections.

Objectives: This study investigated the correlation between vitamin D concentration and the severity of acute respiratory tract infections in infants.

Study design: An analytical cross-sectional study

Place and Duration This study was conducted in unit 1 Civil Hospital Karachi from April 2022 to April 2023.

Methodology: The study examines the link between serum vitamin D concentration and severe acute lower respiratory tract infections (ALRTI) in children aged one month to one year. The study included two groups: a case group of children with severe ALRTI and a control group of children without the infection. The primary outcome measure involved assessing the serum concentration of vitamin D in the two study groups.

Results: The median age of the case group was 5 months, with an interquartile range (IQR) of 4.75 months. The median age of the control group was 4 months, with an IQR of 4 months. The baseline demographic and anthropometric characteristics exhibited no significant differences between the two groups. Nevertheless, it was observed that the median vitamin D levels in the case group were significantly lower compared to the control group ($p < 0.05$).

Conclusion: The findings of our study indicate that vitamin D deficiency represents a significant risk factor for childhood pneumonia, particularly in the context of severe Acute Lower Respiratory Tract Infections (ALRTI). We found that a significant number of infants with ALRTI had a severe deficiency in vitamin D. Notably, the deficiency was seen more in infants who were exclusively breastfed. These findings suggest that increasing vitamin D quantity in diets can help to reduce the chance of severe ALRTI.

Keywords: Respiratory Tract Infections, Infants, Vitamin D

INTRODUCTION

Vitamin D insufficiency is a widely prevalent and often undiagnosed nutritional deficiency in this region of the world [1]. While traditionally linked to calcium balance and bone health, there is a growing awareness of its broader impact on overall health and immunity, including its contribution to the antimicrobial response as well as pulmonary function [2]. The deficiency is more commonly observed in temperate areas, where reduced sun exposure occurs due to factors such as conservative dressing practices [3].

In some religious regions of the World, women adhere to conservative dressing, leading to limited sun exposure and potentially decreasing serum vitamin D levels in the population. This situation may also affect the vitamin D levels of newborn babies and breastfed infants [4]. As a result, our research aims to explore the association between the concentrations of serum vitamin D and the severity of ALRTI in young children (aged 1 month to 1 year) residing in the region under study.

To do this, we looked at how much 25-hydroxyvitamin D was in the blood of the study participants. We did this to find out how vitamin D levels might affect the occurrence and severity of ARTI in this group.

METHODOLOGY

This study followed a hospital-based prospective design. The study focused on young children, aged one month to one year, who had a medical history of severe ALRTI.

The classification of severe ALRI was precisely established using the following criteria:

1. Caregivers reported that the child had a cough and breathing difficulty that persisted for less than two weeks.

2. The respiratory rate of children was assessed according to the WHO, and the presence of consistent intercostal or lower chest wall indrawing during the examination was also considered.

3. During the examination, the study physician noted the occurrence of central cyanosis (bluish discoloration of the skin and mucous membranes due to inadequate oxygenation) and/or inspiratory pulmonary crackles (abnormal lung sounds heard during inhalation) while auscultating the child's chest.

The research included children who met the study's criteria in the case group. However, they excluded children with chronic lung disease or congenital heart disease because these conditions could interfere with the study's results.

The control group consisted of children aged between 1 month and 1 year who attended the clinic and did not have any active complaints related to the respiratory system. Before enrolling the children in the study, written informed consent was obtained from their parents or guardians. The nature and purpose of the study were thoroughly explained to the parents in their native language, ensuring they fully understood the research before giving their consent.

A comprehensive history was obtained from all participants, and a thorough clinical examination, including assessments for signs of rickets, was conducted. Anthropometric measurements, such as weight and height, were taken using standard techniques. The baseline oxygen saturation in room air was monitored using a pulse oximeter in the study group patients. Hypoxia is defined as an oxygen saturation level below 95% in room air.

A blood sample was taken from both the participants in the study group and the control group to measure their levels of vitamin D, calcium, phosphorus, and alkaline phosphatase. These are all important nutrients for bone health, and the levels of these

nutrients can help us understand the risk of bone disease in each group. Additionally, in the case group only, further tests were conducted, including a hemogram, C-reactive protein, electrolytes, and blood culture. These measures allowed for a comprehensive evaluation of the participant's health status and the potential impact of vitamin D levels on the study's outcomes.

Two small vials of blood were taken from a vein in the arm, and then the liquid part of the blood (serum) was separated from the cells by spinning the vials in a centrifuge. The serum samples were subsequently stored at -20°C to preserve their integrity and shielded from direct sunlight until the time of analysis. The analysis was conducted at the end of the period of enrollment.

All determinations were carried out in the Department of Immunology of the hospital. Vitamin D deficiency was defined as having a serum 25-hydroxyvitamin D level (25(OH) D) below 20 nanograms per millilitre (ng/mL). This is the definition used by the American Endocrine Society. By utilizing these standardized procedures and criteria, the study was able to accurately assess the vitamin D status of the participants and identify cases of deficiency as per the established guidelines.

The data was carefully obtained and analyzed using IBM SPSS version 26.

RESULTS

The present study involved a total of 50 infants aged between one month and one year who were diagnosed with severe ALRTI. These cases were compared with 50 age-matched controls. In the case group, 32 patients fell between one and six months of age, while in the control group, there were 30 patients in the same age range (P value > 0.05), indicating no significant difference between the two groups in terms of age distribution.

Clinical rickets were observed in 5 patients within the case group and 4 patients in the control group. The median age (with interquartile range, IQR) for the cases was 5.0 months (IQR: 4.75), while for the controls, it was 4.0 months (IQR: 4.0). However, the difference in median age between the two groups was statistically insignificant (P=0.335). Table 1 in the study presents a comparison of demographic and anthropometric parameters between the case group and the control group.

Table 1: Baseline anthropometric along with demographic parameters of both groups

Variables	Control (n=50)	Case (n=50)	P-value
Male	67%	63%	0.628
Female	33%	37%	
Mean Weight in kg	5.56	5.73	0.288
Exclusively breastfed babies	50%	60%	0.358
Mean height in cm	62.3	63.5	0.301

As evident from Table 1, no notable differences in anthropometric parameters or baseline demographics were seen between the two groups under study. Nonetheless, a significant finding emerged when analyzing the median vitamin D levels. The case group exhibited considerably lower median vitamin D levels compared to the matched controls. This observation suggests that vitamin D levels might have a potential association with the occurrence of severe lower respiratory tract infections in the study population. The disparity in vitamin D levels between the two groups could be a crucial factor in understanding the risk and severity of ALRTI in young children. Further investigation is warranted to delve deeper into this correlation and its implications for the management and prevention of such infections.

DISCUSSION

The insufficiency of Vitamin D is prevalent in infants and young children and is primarily attributed to various factors influencing its availability and absorption. These factors include reduced dietary intake of vitamin D, limited cutaneous synthesis resulting from cultural and religious practices that may limit sun exposure,

seasonal variations affecting sunlight exposure, the practice of keeping infants indoors, increased pigmentation reducing the synthesis of vitamin D in the skin, a rise in the rate of exclusive breastfeeding, and a low concentration of vitamin D in mothers that may impact the passing on of vitamin D to the infant. The combination of these factors can contribute to insufficient vitamin D levels in infancy, necessitating attention to dietary and environmental considerations to prevent and manage deficiencies in this vulnerable population [5]. Based on our findings, it is evident that the deficiency of vitamin D is highly prevalent among infants experiencing severe ALRTI in this region. Furthermore, our study has demonstrated that vitamin D deficiency acts as an independent threatening factor advancing to childhood pneumonia, as indicated by the significantly lower vitamin D concentration in the case group when compared to the control group. These results provide strong evidence supporting the anti-infective role of vitamin D, which aligns with the findings of numerous previous studies that have also highlighted the potential protective effects of vitamin D against various infections. In the study conducted by Williams et al. on childhood tuberculosis, they observed that the patients with tuberculosis had deficient levels of vitamin D. This finding suggests a potential association between vitamin D deficiency and susceptibility to tuberculosis in children. Further research is necessary to explore the implications of this relationship and whether addressing vitamin D levels could be a beneficial approach in the management or prevention of childhood tuberculosis. [6]. Likewise, in another study conducted on Ethiopian children with nutritional rickets, researchers investigated the risk of developing pneumonia. The study revealed a robust positive correlation between vitamin D deficiency and respiratory compromise. This finding underscores the potential significance of maintaining adequate vitamin D levels in children to mitigate the risk of respiratory tract infections and complications such as pneumonia. It adds to the growing body of evidence suggesting the important role of vitamin D in immune function and respiratory health, especially in regions where vitamin D deficiency is prevalent [7].

In our study, we observed that 60% of the case group (patients with severe acute lower respiratory tract infections, or ALRI) were exclusively breastfed. This finding contrasts with many previous studies that have reported a decreased incidence of ALRI in infants exclusively breastfed, suggesting a protective effect of breastfeeding against childhood infections [8].

Our study found that many breastfed babies in our region have a vitamin D deficiency. This deficiency can lead to severe acute lower respiratory tract infections (ALRI), which are a leading cause of death in infants. We believe that the best way to prevent ALRI is to give all breastfed babies 400 units of oral vitamin D every day. The American Academy of Paediatrics (AAP) has made the same recommendation. We hope that our region will adopt this preventive measure so that we can help to reduce the number of infants who die from ALRI.

Ensuring adequate vitamin D levels in breastfed infants can potentially have a positive impact on their immune function and overall health, reducing the risk of respiratory infections and associated complications. Therefore, widespread adoption of this policy may play a crucial role in promoting the well-being of infants in our region and supporting their healthy development.

CONCLUSION

Our study found that the deficiency of vitamin D is a major risk factor that can lead to childhood pneumonia. We found that a high percentage of infants with severe ALRTI had a severe vitamin D deficiency. We also found that exclusively breastfed infants are more likely to be vitamin D deficient.

Suggestions: Vitamin D deficiency is common in our adult population, so it is important to give infants vitamin D supplements to prevent pneumonia. This supplementation is especially important for exclusively breastfed babies, as they face a higher risk of developing this deficiency. By advocating for routine vitamin

D supplementation in our infant population, we aim to address the vulnerability to vitamin D deficiency and potentially reduce the incidence and severity of respiratory infections in this age group. By taking proactive measures to ensure sufficient vitamin D levels, we can promote better overall health and enhance the immune responses of our infants, contributing to improved respiratory health and well-being in the long run.

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