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Relationship between Respiratory Tract Infections and Vitamin D Levels in Children

Dr. Bhoomikaben Rameshbhai Patel[1], Dr. Hardik Arvindkumar Shah[2], Dr. Naiya J. Bhavsar

[1,2]Assistant Professor, Department of Pediatrics, Dr. M.K. Shah Medical College and Research Centre, Ahmedabad, Gujarat, India

[3]Senior Resident, Department of Pulmonary Medicine, Dr. M.K. Shah Medical College and Research Centre, Ahmedabad, Gujarat, India

Corresponding author: Dr. Naiya J. Bhavsar, Department of Pulmonary Medicine, Dr. M.K. Shah Medical College and Research Centre, Ahmedabad, Gujarat, India

Abstract

Background and Aim: Acute respiratory tract infection are a major cause of global morbidity and mortality. Observational studies report consistent independent association between low serum concentration of 25-hydroxy-vitamin D and susceptibility to acute respiratory tract infection. The study aimed to compare the serum vitamin D levels in children experiencing various types of acute lower respiratory infections (ALRI) with those who were healthy, to explore any potential relationship between vitamin D status and respiratory health.

Material and Methods: The study involved participants aged between six months and five years. A case group was formed by a collection of children who were admitted to the hospital due to respiratory illnesses, including asthma, acute bronchiolitis, and pneumonia. The children designated as controls were those receiving medical care in the hospital's outpatient, emergency, or inpatient departments. The diagnosis of ALRI was determined by using clinical, radiographic,

and biochemical findings. The serum vitamin D levels of all patients included in the study, along with the ages of the normal control children, were thoroughly assessed.

Results: The current study included a total of one hundred children, with ages spanning from six months to five years old. Two groups of children were identified: one designated as the case group and the other as the control group. Conversely, the occurrence of bronchial asthma and bronchopneumonia was found to be 55% and 39% respectively in children with vitamin D deficiency. Among children with insufficient vitamin D levels, 53 percent experienced acute bronchiolitis, while 39 percent were affected by bronchopneumonia. The analysis revealed no significant difference in vitamin D levels between patients diagnosed with pneumonia and those experiencing wheeze-associated respiratory illnesses (WARI).

Conclusion: Vitamin D supplements have the potential to decrease the incidence of upper respiratory tract infections (URTIs) and lessen the severity of respiratory tract diseases.

Key Words: Acute respiratory tract infection, Children, Pneumonia, Vitamin D

Introduction

Acute respiratory tract infection stands as the most prevalent infectious disease and is the leading cause for individuals seeking care in emergency departments and for unscheduled outpatient visits. Upper respiratory tract infections (URTI), often referred to as the "common cold," represent the most prevalent infectious disease worldwide. Over two hundred distinct viruses contribute to the clinical syndrome characterised by symptoms such as sneezing, coughing, nasal congestion, nasal discharge, and a sore throat. The terms "upper respiratory tract infection" (URTI) and "lower respiratory tract infection" (LRTI) are both part of the acronym ACRI. The influenza virus and the common cold represent the most prevalent acute respiratory tract infections (ARTIs) globally. During the winter months in temperate regions, we observe the

highest incidence of acute respiratory tract infections (ARTIs). In contrast, tropical regions experience minimal seasonal variation in the occurrence of these infections.[1,2]

To ensure the optimal functioning of the human body, vitamin D plays a crucial role. Insufficient and deficient levels of vitamin D are associated with heightened proinflammatory cytokine levels in the lungs, along with reduced antiviral activity in individuals experiencing viral respiratory infections. A Japanese cohort study revealed that low levels of circulating 25(OH)D are linked to an increased risk of mortality from respiratory infections. Research indicates that metabolites of vitamin D may stimulate additional innate antimicrobial effector mechanisms. The mechanisms involved encompass the initiation of autophagy along with the production of reactive nitrogen intermediates and reactive oxygen intermediates.[3-5]

A lack of vitamin D is recognised as a contributing factor to rickets and can also lead to delays in skeletal growth.[6] Research conducted in developing countries has demonstrated a correlation between nutritional rickets and pneumonia. In a study, radiological evidence of pneumonia was identified in 43 percent of 200 children diagnosed with rickets in Iran, and in 44 percent of 250 children in Kuwait. Subclinical vitamin D deficiency poses a considerable risk for severe acute lung injury (ALRI) in children under five years old of Indian descent in India.[7] Research indicates a link between low serum vitamin D levels and a higher occurrence of respiratory infections, including respiratory syncytial virus disease, in children and infants under the age of five. The study aimed to compare the serum vitamin D levels in children experiencing various types of acute lower respiratory infections (ALRI) with those who were healthy, to explore any potential relationship between vitamin D status and respiratory health.

Materials and Methods

This study focuses on the case control analysis conducted in the department of pediatrics, in collaboration with the medical college and the associated hospital. The research project was completed over a span of six months. The study involved participants aged between six months and five years. The parents of the children involved in the study received thorough information about the research, and their consent was secured before their children's participation. The study employed specific inclusion and exclusion criteria to effectively select the cases and controls.

Inclusion Criteria

All children aged six months to five years who attended the Department of Paediatrics Medicine underwent examinations, both externally and internally. Children who experienced a respiratory tract infection were also included in the study. In this study, we included a control group consisting of children of the same age and gender who presented to the hospital with complaints unrelated to respiratory issues.

Exclusion Criteria

Examples of children with congenital heart disease include those with asthma and allergies, those diagnosed with tuberculosis, those receiving prophylactic vitamin D supplementation, and those with immune deficiencies or undergoing immunosuppressive therapy.

A case group was formed by a collection of children who were admitted to the hospital due to respiratory illnesses, including asthma, acute bronchiolitis, and pneumonia. The children designated as controls were those receiving medical care in the hospital's outpatient, emergency, or inpatient departments. The children in this case reported issues that were unrelated to their respiratory health and showed no clinical signs of a vitamin D deficiency. The controls exhibited

uniformity regarding age, gender, and nutritional status. Every child who experienced a respiratory tract infection was classified as a case. We selected children of the same age and gender who had presented to the hospital with complaints unrelated to respiratory issues to serve as a control group.

A thorough clinical evaluation was conducted, including a general physical examination and a detailed systemic examination, with special attention given to the respiratory system. The diagnosis of ALRI was determined by using clinical, radiographic, and biochemical findings. The weight was determined using an electronic weighing scale with an accuracy of 5 grammes. The WHO multicentric growth reference study serves as a valuable resource for assessing the appropriate weight relative to an individual's age. Once the child turned two years old, the infantometer (ADE, Germany) was utilised to measure the child's length with precision up to the nearest centimetre, while the stadiometer was employed for height measurements thereafter. The serum vitamin D levels of all patients included in the study, along with the ages of the normal control children, were thoroughly assessed. To assess the serum 25(OH) vitamin D level, it was essential to gather a clotted blood sample of 0.5 millilitres from each individual. The enzyme immunoassay kit was used to measure the serum 25(OH) vitamin D concentration. To conduct the statistical analysis, we began by inputting the data into a spreadsheet developed in Microsoft Excel. Following this, we utilized SPSS software to analyze the data effectively.

Results

The current study included a total of one hundred children, with ages spanning from six months to five years old. Two groups of children were identified: one designated as the case group and the other as the control group. The two groups were evenly split. In the case group, there were fifty children experiencing an infection of the respiratory tract. Meanwhile, the control group

also consisted of fifty children who were healthy but visited the hospital for unrelated complaints that did not involve their respiratory system.

Over fifty percent of the participants in the study were aged between one and two years. The study included fifty cases, comprising twenty-six males and twenty-four females. In comparison, the control group also consisted of fifty participants, with an equal distribution of twenty-five males and twenty-five females. The attendance comprised 51% males and 49% females. Conversely, the occurrence of bronchial asthma and bronchopneumonia was found to be 55% and 39% respectively in children with vitamin D deficiency. Among children with insufficient vitamin D levels, 53 percent experienced acute bronchiolitis, while 39 percent were affected by bronchopneumonia. The analysis revealed no significant difference in vitamin D levels between patients diagnosed with pneumonia and those experiencing wheeze-associated respiratory illnesses (WARI).

In all three categories of vitamin D status, a statistically significant difference was observed between the cases and the controls, with a higher proportion of the controls exhibiting adequate levels of vitamin D.

The cases exhibited a mean serum vitamin D level of 18.22 ± 6.41 ng/ml, in contrast to the control group, which showed a mean serum vitamin D level of 27.22 ± 5.47 ng/ml. The p value for the control group was below 0.05, suggesting that the results are statistically significant.

Table 1: Distribution of mean vitamin D level in cases and control.

Groups	Average Vit D level (ng/ml)	P value
Case group	18.22 ± 6.41	< **0.001**
Control group	27.22 ± 5.47	

Discussion

Additionally, vitamin D may contribute to various health outcomes, including its potential impact on infections, while also being crucial for skeletal health. The serum concentration of 25-hydroxyvitamin D (25(OH)D) is measured to assess vitamin D status. The concentration of this substance fluctuates with the seasons, reaching its lowest levels in winter and spring. This period also aligns with the peak occurrence of acute respiratory tract infections (ARTI). Research indicates a potential link between vitamin D levels and cardiovascular disease. Laboratory studies reveal the important role of vitamin D in supporting the immune system, reinforcing this assertion. Vitamin D plays a crucial role in eliminating pathogens and also helps to prevent the onset of prolonged inflammatory responses.[7,8]

Acute respiratory tract infections significantly impact health and contribute to illness and death worldwide. These conditions account for ten percent of visits to ambulatory and emergency departments, and they were estimated to be responsible for two and a half million deaths globally in 2013.Research indicates a reliable and independent link between low levels of 25-hydroxyvitamin D, the primary circulating form of vitamin D, and an increased risk of acute respiratory tract infections, as demonstrated by two observational studies.[9,10]

The increasing occurrence of vitamin D deficiency is concerning and can be linked to insufficient sunlight exposure, various social and cultural practices, and dietary choices that fail to meet the daily vitamin D needs. Vitamin D not only helps restore immune function but also contributes to lowering cytokine levels, highlighting its important role in the immune system. Vitamin D deficiency leads to an elevated release of proinflammatory cytokines such as IL-6 and TNF-alpha. The research findings indicate that the average serum vitamin D level was

significantly lower ($p < 0.01$) in the cases when compared to the control group. This finding indicates that insufficient vitamin D levels in children may be linked to a higher risk of respiratory tract infections.

Conclusion

Vitamin D supplements have the potential to decrease the incidence of upper respiratory tract infections (URTIs) and lessen the severity of respiratory tract diseases. Research indicates that a low level of 25-hydroxyvitamin D in the serum is linked to a higher risk of respiratory infections. To ensure the accuracy of our findings, it is essential to conduct further research on infections that have been confirmed through laboratory testing.

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