Section: Pediatrics

Research

SERUM VITAMIN D LEVELS ESTIMATION IN CHILDREN UNDER 5 YEARS OF AGE WITH RESPIRATORY ILLNESS: A CROSS SECTIONAL STUDY

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Abstract

Background: Acute respiratory infections are the leading cause of hospitalisation for children younger than five years old, accounting for more than 12 million admissions annually. To estimate proportion of vitamin D deficiency in children under 5 years of age with respiratory illness. **Materials and Methods:** The present cross-sectional study was carried out at the paediatrics Department of Rohilkhand Medical College and Hospital in Bareilly, Uttar Pradesh. **Result:** Majority (77.8%) of our study children were male gender. 73.3% children were presented with cough, 71.1% had difficulty in breathing, 64.4% presented with wheeze and 44.4% children had cold. In 64.4% children had increased respiratory rate. 46.7% children were suffering from pneumonia followed by bronchiolitis and lower respiratory tract infection 22.2% each. In 6.7% children x-ray findings were showing emphysema and in that only one (2.2%) case were tuberculosis. The average vitamin D level of the studied children was 24.19 ± 7.92 with minimum 8.7 ng/ml to maximum 42.0 ng/ml. **Conclusion:** Children with recurrent respiratory tract infections had Vitamin D deficiency. Vitamin D deficiency and number of respiratory tract infections are more in male children than female children. Vitamin D deficiency and number of respiratory tract infections are more in the 24-60 months age group followed by ≤12 months and 13-24 months age. As most of the children are deficient in serum Vitamin D levels, routine Vitamin D supplementation may be recommended from birth onwards.

INTRODUCTION

ARI is an acute respiratory infection (ARI) that has the ability to disturb a person's usual breathing patterns, and it can be spread from one person to another.[1] More than two million to six million deaths were attributed to lower respiratory infections over the world, making them the fifth largest cause of death overall and the leading cause of mortality in children younger than five years of age. In addition, lower respiratory infections were the leading cause of death in adults aged 65 and older.[2] Infections of the upper respiratory tract that are more prevalent in children include the common cold, pharyngitis, and otitis media. The peak incidence of upper respiratory tract infections occurs between the ages of infancy and five years.

Due to the presence of specific risk factors, acute respiratory infections are more likely to occur in children of younger age groups. The great majority of the risk factors are amenable to being changed in one way or another. Children's susceptibility to developing acute respiratory infections is strongly influenced by both the elements of their environments and the circumstances of their living spaces. Children are at a greater risk of being affected, particularly in countries that have not yet reached their full potential, particularly if they were born with a low birth weight and hunger is a prevalent problem.[3]

Vitamin D, widely known as the "sunshine vitamin," is not only a nutrient but also a prohormone that plays a broad range of roles inside the human body. Vitamin D is produced by the body in response to

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exposure to sunlight.[4] When discussing fat-soluble secosteroids, the word "prohormone" is used to refer to a specific type. Vitamin D2, also known as ergocalciferol, and vitamin D3, commonly known as cholecalciferol, are the two principal forms. Vitamin D3 is frequently referred to as cholecalciferol. It is the role that vitamin D plays in the absorption of calcium from the small intestine that is the function of vitamin D that is understood the best. As a result of this effect of vitamin D, adults can reduce their risk of developing osteoporosis and osteomalacia, while children can reduce their risk of developing rickets.[5,6] There is mounting evidence that vitamin D has a beneficial effect on tissues that are not a part of the skeleton. These tissues include the muscles and the brain. In addition to its essential role in the process of forming and maintaining the skeleton, it also plays a role in the production of teeth. Tissues such as the brain, heart, stomach, pancreas, lymphatics, skin, gonads, and prostrate tissue are examples of those that are composed of cells that express the vitamin D receptor. These cells include T lymphocytes and B lymphocytes. These types of cells can also be found in other tissues, such as the lymphatics, the skin, and the gonads (VDR). Vitamin D is thought to play a role in both the improvement of immune system function and the reduction of inflammation in these tissues. Both of these effects are desirable.[7] As a consequence of this, there is a growing body of data that suggests that children who drink vitamin D may have a decreased chance of having respiratory tract infections.[8,9] In the beginning, tuberculosis was considered to be the prototypical disease link; however, there are now studies that support a connection with several other respiratory tract infections, including acute otitis media, pharyngotonsillitis, rhinosinusitis, bronchiolitis, and pneumonia.[10,11]Hence the study was conducted to estimate proportion of vitamin D deficiency in children under 5 years of age with respiratory illness.

MATERIALS AND METHODS

The present cross-sectional study was carried out at the Paediatrics Department of Rohilkhand Medical College and Hospital in Bareilly, Uttar Pradesh. For either gender children between the ages of six months and five years old who were diagnosed with a respiratory ailment and either brought to the outpatient department or hospitalized to the Paediatric unit. Duration of study was from 1st November 2020 to 31st October 2021. Ethical approval was obtained from the institution's ethics committee.

Sample Size: Sample size is 45 children. Sample size is calculated on the basis of proportion of subjects having low Vitamin D level (< 25nmol/L)
$n=4\times P\times Q / L2$

Where: - P = 43% (prevalence), Q = 100-P; Q = 57%; L=15% (absolute allowable error).

Inclusion Criteria

- Children presenting to paediatric department with pulmonary manifestations like cough, cold, wheeze and with other signs of respiratory distress with or without fever.
- Children whose parents have given informed consent will be enrolled for the study.

Exclusion Criteria

- Children who were born prematurely or with a low birth weight. Children who were taking vitamin D supplements. Children who were using medications that affected the metabolism of vitamin D.
- Children who suffer from a variety of different systemic disorders.
- Children suffering from a variety of metabolic problems.
- Children who were known to be deficient in vitamin D.
- Disorders affecting the endocrine system in children
- Children who have been born with a birth defect Children who have been diagnosed with a genetic disease

Study Tool: Predesigned proforma for data collection (Semi structured Clinical Data Sheet), Consent form and Socio-demographic data sheet.

Methodology: In the patient's native language, information on the study was conveyed to the parent, and informed consent was acquired before the kid was included in the research. A comprehensive history which included their demographic history, birth history, dietary and feeding history, immunisation history, socioeconomic status, family history, and history of Koch's contact. Additionally, age-dependent anthropometry variables, a head-to-toe examination, and a systemic examination were performed using the prescribed proforma. Investigations such as serum vit D3 (by ELISA, ECLIA), true NAT (for hospitalized patients), and other investigations such as complete blood count, serum calcium, and x ray chest and wrist were done as necessary. ELISA is an enzyme-linked immunosorbent assay.

Blood Sampling

In order to determine the levels of serum 25 (OH) D, calcium, phosphorus, and alkaline phosphatase in these patients, blood samples were taken from each of them. The fully automated chemiluminescence immunoassay approach was utilised in the biochemical tests for serum 25(OH) D levels that were carried out in RMCH Laboratories by 25-OH Vitamin D ELISA Test and Access 25(OH) Vitamin D Total ECLISA Method.

In the hospital's central laboratory, the ionic calcium in the serum was measured using the calcium arsenazo technique, the serum phosphorus was

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measured using the colorimetry method, and the alkaline phosphatase was assessed using the p-nitro phenyl phosphate kinetic method.[12]

Table 1: The vitamin D status was categorized as follows,[13]

Severe deficiency	<5 ng/ml
Deficiency	5-15ng/ml
Insufficiency	15-20ng/ml
Sufficiency	20-100ng/ml
Excess	>100ng/ml
Intoxication	>150 ng/ml

Statistical Analysis: The Statistical Package for the Social Sciences, version 23, was utilised in the analysis of the data (SPSS Inc., Chicago, IL). Finding the relevance of research parameters on a categorical scale between groups has been accomplished through the use of either the Chi-square test or Fisher's exact test as well as the two-tailed, independent Student test. Significance level of P less than 0.05 would serve as the cut off value.[14]

RESULTS

The age range of children who were examined for this study was less than 5 years, and the vast majority (77.8%) of the children that we evaluated were of the male gender. Children were presenting with a cough in 73.3% of cases, trouble in breathing in 71.1% of cases, wheezing in 64.4% of cases, and a cold in 44.4% of cases. There is a rise in the child's respiratory rate in 64.4% of cases.

Table 2: Age, sex, symptoms and sign wise distribution of studied children

		Frequency (n=45)	Percentage
Age Group (Months)	<12	12	26.7%
	13-24	11	24.4%
	25-60	22	48.9%
	Mean±SD	29.64±17.24	
Sex	Male	38	77.8%
	Female	10	22.2%
Symptoms & Sign	Cough	33	73.3%
	Cold	20	44.4%
	Difficulty in Breathing	32	71.1%
	Wheeze	29	64.4%
	Increase Respiratory Rate	29	64.4%

The diagnosis of respiratory sickness is represented in table no. 4 below. Of the children who were unwell with a respiratory condition, 46.7% had pneumonia, followed by bronchiolitis (22.2%) and lower respiratory tract infection (22.2%) respectively. The remaining 6.7% of youngsters showed signs of emphysema, and there was just one incidence of TB (2.2%).

Table 3: Diagnosis of Respiratory Illness in studied children

Respiratory Illness	Frequency (n=45)	Percentage
Pneumonia	21	46.7%
Bronchiolitis	10	22.2%
Lower respiratory tract infection	10	22.2%
Emphysema	3	6.7%
Tuberculosis	1	2.2%

In our studied children 31.1% cases were having insufficiency (≤20 ng/ml) vitamin D level while rest others were having sufficiency (>20 ng/ml) vitamin D level. The average of the vitamin D of the studied children was 24.19±7.92 with minimum 8.7 ng/ml to maximum 42.0 ng/ml.

Table 4: Vitamin D status in studied children

Vitamin D status	Frequency (n=45)	Percentage
Insufficiency (≤20 ng/ml)	14	31.1%
Sufficiency (>20 ng/ml)	31	68.9%
Mean± SD (min to max)	24.19±7.92 (8.7 to 42.0ng/ml)	

It was found that children diagnosed with respiratory illnesses such as tuberculosis, emphysema, and pneumonia were more prevalent in the vitamin D insufficient group.

Table 5: Vitamin D level wise distribution among respiratory illness under 5 years of age children

Respiratory Illness	Vitamin level (ng/ml)		P value
	≤20 (n=14)	>20 (n=31)	
Pneumonia	8 (57.1%)	13 (41.9%)	0.130
Bronchiolitis	2 (14.3%)	8 (25.8%)	
Lower respiratory tract infection	1 (7.1%)	9 (29.0%)	
Emphysema	2 (14.3%)	1 (3.2%)	
Tuberculosis	1 (7.1%)	0 (0.0%)	

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It was discovered that children with TB and emphysema showed a drop in vitamin D levels, although the difference was not statistically significant.

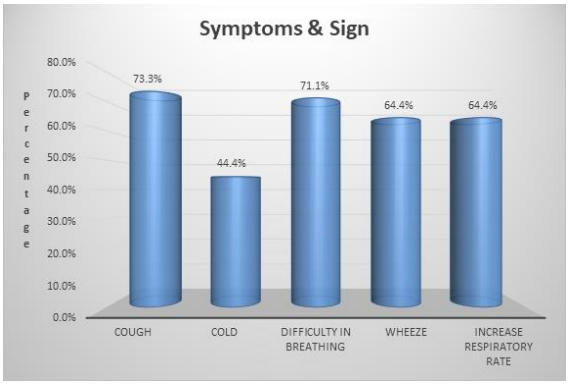

Figure 1: Symptoms & Sign wise distribution of studied children

DISCUSSION

Growing evidence suggests that in addition to calcium homeostasis, vitamin D also plays key roles in innate and adaptive immunity. As a result, a vitamin D deficiency has been hypothesized to be a culprit in the risk and severity of acute respiratory infection (ARI) in both adults and children. This is because vitamin D plays key roles in both innate and adaptive immunity.

The creation of vitamin D3 in the skin in response to exposure to sunshine is the initial step in the biosynthesis of the active form of vitamin D in humans. It is plausible; given the effects that vitamin D has on the immune system, that the seasonality of ARI could be caused in part by periods of active vitamin D insufficiency during the winter and early spring months. This could be attributed to lower rates of skin conversion to D3, which occurs during these months. Despite the fact that a number of studies have already demonstrated a link between low levels of 25-OH vitamin D and an increased risk of ARI in participants.[15,16]

We conducted research to determine whether or not there was a connection between the levels of 25-OH vitamin D and the severity of respiratory illnesses in children less than 5 years old. We made the assumption that the severity of the condition would be greater in children under 5 years old whose levels of 25-OH vitamin D were lower. R. Chowdhury et al,[17] conducted a randomized controlled trial of the vitamin-D deficiency predicts infections in young north Indian children and concluded that the Vitamin-D deficiency is associated with a higher risk of ALRI. Fairchok M et al,[18] has made a prospective cohort study of the inverse Correlation between 25-OH Vitamin D Levels and Severity of Viral Respiratory Illness in Infants and concluded the infants with 25-OH vitamin D insufficiency had more severe viral respiratory illnesses. Garg D et al,[19] band concluded the subclinical vitamin D deficiency is significant risk factors for severe ALRI in Indian children of less than 5 years of age.

Children born prematurely or with a low birth weight, children taking vitamin D supplements or medications that affect the metabolism of vitamin D, children with other systemic diseases, children with other metabolic disorders, children with congenital anomalies, and children with genetic disorders were not included in the study. Chowdhury R et al,[17]Fairchok M et al,[18]Garg D et al.[19]

All the subjects of our study were belonging to age group under 5 years of age and there were majority (77.8%) of study children were male gender. Our study was similar to several other studies like that of Garg D et al,[19] and Ruhi A & Ananth T,[20] who included children of <5 years of age.

According to the findings of our study, 73.3% of children had a cough, 71.1% of children had difficulties breathing, 64.4% of children presented with wheezing, and 44.4% of children had a cold. There is a rise in the child's respiratory rate in 64.4% of cases.

According to the findings of our research, 46.7% of children had pneumonia, followed by bronchiolitis (22.2%) and lower respiratory tract infection (22.2%) respectively. The remaining 6.7% of youngsters showed signs of emphysema, and there was just one incidence of TB (2.2%). Garg D et al,[19] In the cases that were reported, 47.5% were diagnosed with pneumonia (35% of those cases were bronchopneumonia and 12.5% were lobar pneumonia), and 52.5% of those patients belonged to the WARI group (40% of those cases were acute bronchiolitis and 12.5% were bronchial asthma). In Nigeria, Ahmed P. et al. discovered that ALRTI was associated with less exposure to sunshine rather than the presence or absence of vitamin D.[21] Similarly, McNally JD et al found no significant difference in vitamin D levels between the entire ALRI group and control groups.[22]

In the children that we analysed, the vitamin D levels of 31.1% of the cases were insufficient (less than 20 ng/ml), whereas the vitamin D levels of the remainder of the children were enough (more than 20 ng/ml). The vitamin D levels of the children who were tested ranged from a low of 8.7 ng/ml to a high of 42.0 ng/ml, with a mean value of 24.197.92.

CONCLUSION

According to the findings of our research, having trouble breathing, having a wheeze, and having an increased respiratory rate are all significantly associated with the severity of respiratory illness. On the other hand, age, sex, and vitamin D level are not significantly associated with the severity of respiratory illness. According to the findings of our

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research, patients who suffered from pneumonia, emphysema, and tuberculosis had vitamin D levels that were insufficient, but patients who suffered from bronchiolitis and LRTI had vitamin D levels that were enough.

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