

Original Research Article

Prevalence of vitamin D deficiency in children with lower respiratory tract infection

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ABSTRACT

Background: Vitamin D has a role in lung growth, preserving lung function, and preventing pulmonary infection.

Methods: Hospital based cross sectional prospective study was done for a period of one year from January 2017 to December 2017, at the AJ Institute of Medical Sciences, Mangalore. A total of 69 patients were admitted with LRTI during the duration of 1 year, which includes pneumonia and bronchiolitis. Out of 69 patients admitted with LRTI, 10 were excluded from the study as they were not fulfilled the criteria.

Results: A total 59 children were enrolled in the study with LRTI, out of which 50 (84.7%) were vitamin D deficiency 6 (10.1%) were insufficiency and only 3 (5.08%) had normal vitamin D values, which was statistically highly significant with p value <0.05. Vitamin D deficiency is more common in less than 1 year and also in male child. Vitamin D deficiency is also common among preterm babies who were not on Vitamin D supplements, exclusively breast fed babies and among lower socio economic status especially in class 4. Authors found that 13 (22.03%) members were having a history of previous LRTI out of which 11 (84.6%), 2 (15.3%) had Vitamin D deficiency and insufficiency respectively. Among study group, 16 (27.11%) were diagnosed to have bronchiolitis, out of which 10 (62.5%), 4 (25%), 2 (12.5%) patients were found to have Vitamin D deficiency, insufficiency and normal values respectively. Children who diagnosed as pneumonia were 43 (72.88%), out of them 40 (93%), 2 (4.6%), 1 (2.3%) were having deficiency, insufficiency and normal values of Vitamin D respectively.

Conclusions: Vitamin D deficiency is common in children with LRTI especially among exclusively breastfed, born preterm and children from lower socio economic status. Early recognition and treatment of Vitamin D deficiency can prevent morbidity associated with rickets and possibly frequent LRTI.

Keywords: Children, Lower respiratory tract infections, Prevalence, Vitamin D deficiency

INTRODUCTION

Vitamin D is a fat-soluble vitamin and plays a very important part in human physiology.¹ Scientific evidence indicates that calcium and Vitamin D play an important role in mineralization of bone, muscle contraction, nerve conduction, and general cellular function, immune function, for inflammation, cell proliferation, and differentiation.^{2,3}

Recent studies suggest that vitamin D has a role in lung growth, preserving lung function, and preventing pulmonary infection.⁴ The largest study comes from the Third National Health and Nutrition Examination Survey (NHANES III) data, which showed in healthy adults those with the highest 25-hydroxyvitamin D (25-OHD) levels had significantly higher FVC and FEV1 than those with the lowest 25-OHD levels.⁵ In healthy infants and

children, vitamin D deficiency has been associated with a higher risk of and more severe respiratory infections.⁶

The major source of Vitamin D is the endogenous synthesis in skin on exposure to sunlight, namely, ultraviolet B (UV-B) radiation of wavelength 290-320nm. There is a general belief that vitamin D deficiency and rickets are uncommon in India because of abundant sunshine. However that is not true as the data shows that Vitamin deficiency is quite prevalent.^{7,8} Vitamin D deficiency and insufficiency has many causes, but lack of awareness of the importance of this deficiency in individual and public health is an crucial factor. The city of Dakshina Kannada is a smart city with a good percentage of population in the paediatric age group. There has been a recent change in the city with increase in industrialization, adaptation of the western way of weaning and food habits that can impact a child's health.

Lower respiratory tract infections (LRTI) are among the most important causes of morbidity and mortality in the childhood, approximately two million children aged below five years die each year because of pneumonia.⁹

Risk factors for the development of acute lower respiratory tract infection (ALRI) include low birth weight, nonexclusive breastfeeding, incomplete immunization, indoor air pollution, crowding, parental smoking, and chronic disease.¹⁰ It is also hypothesized that the reduction of ultraviolet-B (UVB) radiation exposure during winter is associated with decreased vitamin D production that could account partly for the increased prevalence of ALRI during winter months.¹¹ In developing countries there is an association between the risk of ALRI and both rickets and subclinical vitamin D deficiency in children.¹² During the winter months, when vitamin D synthesis is naturally diminished because of the decreasing hours of sunlight, angle of solar radiation and skin exposed, acute lower respiratory infections are more frequent in adults and children. Vitamin D is thought to play an important role in immune system regulation, and can potentially protect against infections, in addition to cancer, cardiovascular disease and autoimmune disorders such as type 1 diabetes.

The research center and that attached hospital where this study is conducted is a tertiary care center which receives a good case load of children with LRTI, vitamin D deficiency and also this center had the latest technology and equipment necessary to assay Vitamin D levels.

In view of this authors conducted a study to find out the relationship between vitamin D deficiency and LRTI in the age group six months to five years.

METHODS

Hospital based cross sectional prospective study was done for a period of one year from January 2017 to December 2017, at the AJ Institute of Medical Sciences,

Mangalore. Total 69 patients were admitted with LRTI during the duration of 1 year, which includes pneumonia and bronchiolitis. Out of 69 patients admitted with LRTI, 10 were excluded from the study as they were not fulfilling the criteria. Study was done after taking informed consent from parents and ethical clearance from institutional ethical clearance committee.

Inclusion criteria

- Children between the age of six months to five years
- Only who were admitted in the ward with diagnosis of LRTI.

Exclusion criteria

- Children already on Vitamin D supplements
- Children who were on anticonvulsants, anti tubercular drugs and glucocorticoids
- Children who had congenital skeletal disorders, congenital heart diseases, congenital lung disorders.

A detailed careful history has been obtained from parents regarding gestational age at birth, birth weight, period of exclusive breast feeding, dietary intake of milk and egg, exposure to sunlight, clinical features suggestive of rickets and present illness for which child was admitted.

Venous samples were taken and were tested for estimation of serum 25 OH Vitamin D, complete blood count, serum calcium, serum phosphorus and alkaline phosphatase levels. X ray chest done. X ray wrist and or knee were done whenever required.

Following cut off values were taken for 25 OH Vitamin D levels as per US endocrinology guidelines.¹³

- Normal value of vitamin D taken as >30ng/ml
- Insufficiency as 20 to 30ng/ml
- Deficiency as <20ng/ml.

Statistical analysis

The demographic characteristics of the sample were summarized using descriptive statistics. The various characteristics were described using frequency and percentage. The findings in were correlated to using inferential analysis chi-square, ANOVA and analysis of variance done at level of significance $p < 0.05$.

All analysis was conducted using SPSS- version 22.

RESULTS

A total 59 children were enrolled in the study with LRTI, out of which 50 (84.7%) were vitamin D deficiency 6 (10.1%) were insufficiency and only 3 (5.08%) had normal vitamin D values, which was statistically highly significant with p value < 0.05 (Figure 1).

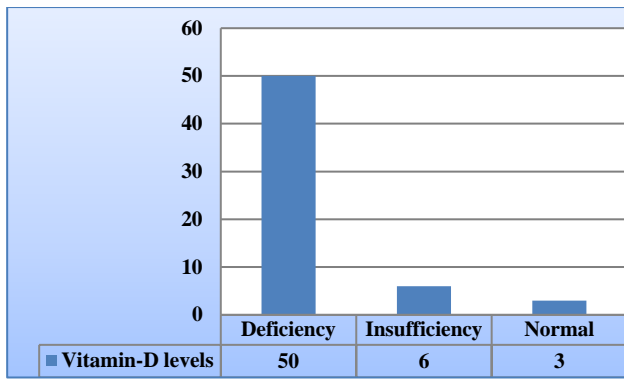


Figure 1: Prevalence of vitamin D deficiency in children with LRTI.

Vitamin D deficiency is more common in less than 1 year and also in male child. Vitamin D deficiency is also common among preterm babies who were not on vitamin

D supplements, exclusively breast fed babies and among lower socio economic status especially in class 4. Authors didn't have any cases from classes 1 and 2 (Table 1).

Among 59 patients, 16 (27.11%) were diagnosed to have bronchiolitis, out of which 10 (62.5%), 4 (25%), 2 (12.5%) patients were found to have Vitamin D deficiency, insufficiency and normal values respectively. Children who diagnosed as pneumonia were 43 (72.88%), out of them 40 (93%), 2 (4.6%), 1 (2.3%) were having deficiency, insufficiency and normal values of vitamin D respectively (Table 2).

In present study authors found that 13 (22.03%) patients were having a history of previous LRTI out of which 11 (84.6%), 2 (15.3%) had vitamin D deficiency and insufficiency respectively. None of them were found to have normal values of Vitamin D (Table 3).

Table 1: Demographic profile of cases.

Characteristic		Total	Deficiency	Insufficiency	Normal
Age	6months-1year	12 (20.3%)	12 (100%)	-	-
	1 year-5 year	47 (79.6%)	38 (80.8%)	6 (12.7%)	3 (6.3%)
Sex	Male	35 (59.3%)	31 (88.5%)	4 (11.4%)	-
	Female	24 (40.6%)	19 (79.16%)	2 (8.3%)	3 (12.5%)
Gestational age	Term	55 (93.2%)	46 (83.6%)	6 (10.9%)	3 (5.4%)
	Preterm	4 (6.7%)	4 (100%)	-	-
Exclusively breast fed	Yes	48 (81.3%)	43 (89.5%)	3 (6.25%)	1 (2.08%)
	No	11 (18.6%)	6 (54.5%)	3 (27.27%)	2 (18.18%)
Socio economic status	3	7 (11.86%)	5 (71.4%)	1 (14.2%)	1 (14.2%)
	4	45 (76.2%)	39 (86.6%)	4 (8.8%)	2 (4.4%)
	5	7 (11.86%)	6 (85.7%)	-	1 (14.2%)

Table 2: Prevalence of vitamin D deficiency among the types of LRTIs.

Type	Total	Deficiency	Insufficiency	Normal
Bronchiolitis	16 (27.11%)	10 (62.5%)	4 (25%)	2 (12.5%)
Pneumonia	43 (72.88%)	40 (93%)	2 (4.6%)	1 (2.3%)

Table 3: Prevalence of vitamin D deficiency in recurrent LRTIs.

Total	Deficiency	Insufficiency	Normal
13 (22.03%)	11 (84.6%)	2 (15.3%)	0

DISCUSSION

The study demonstrated that there is a significant correlation between lower levels of vitamin D and LRTI. Out of 59 cases with LRTI 50 (84.7%) had Vitamin D deficiency, 6 (10.1%) had insufficiency and 3 (5.08%) had normal Vitamin D values which was statistically significant. Children with pneumonia were 43 (72.88%) out of 59, among them 40 (93%), 2 (4.6%), 1 (2.3%) had deficiency, insufficiency and normal values of Vitamin D

respectively. Authors also found that 13 (22.03%) members were having a history of previous LRTI out of which 11 (84.6%), 2 (15.3%) had vitamin D deficiency and insufficiency respectively.

A matched cohort study was done from January 2009 to December 2013 in the Affiliated Children's Hospital of Capital Institute of Pediatrics, Beijing, China. This cohort is regarded as a one-center observational study at a 400-bed tertiary teaching hospital, which has more than 3,000

pneumonia-related admissions annually. This study investigated the impact of vitamin D status on the susceptibility and severity of viral pneumonia in children. A total of 236 children with viral pneumonia, aged from 1 month to 14 years, and 271 gender and age matched healthy children to compare the serum 25(OH)D levels and vitamin D status. Vitamin D indices were compared between subgroups in viral pneumonia cases. The median [interquartile range (IQR)] serum 25(OH)D level in these 507 children was 23.7 (IQR 17.5-30.6)ng/mL; 134 (26.4%) children were vitamin D sufficient [25(OH)D > 30 ng/mL], whereas 373 (73.6%) were insufficient, which included insufficient [25(OH)D 20-30ng/mL], deficient [25(OH)D 10-20ng/mL], and severely deficient [25(OH)D < 10ng/mL]. The median (IQR) serum 25(OH)D level in the viral pneumonia group was significantly lower than that in the control group [19.6 (12.3-26.4)ng/mL versus 26.6 (21.4-32.9)ng/mL] (P <0.001). The proportions of vitamin D deficiency (32.2% versus 19.5%) and severe deficiency (19.1% versus 0.4%) in the viral pneumonia group were significantly higher than those in the control group.¹⁴

Another prospective study was carried out at the neonatal intensive care unit of Abha General Hospital, Abha city, Saudi Arabia between December 2008 and July 2011. Cord blood from 206 newborns was tested for 25 (OH) D. Medical records covering the first 2 years of life were reviewed, and the diagnosis of ALRI was recorded. Results: Sixty-two (30.1%) infants developed ALRI in their first 2 years of life, of whom 49 (79%) infants had bronchiolitis and 13 (21%) infants had pneumonia. Concentrations of 25 (OH) D were lower in infants who developed ALRI compared with those did not (p <0.0001). Vitamin D deficiency was associated with increased risk of ALRI (p ¼ 0.000).¹⁵

Similarly, case control study was conducted to determine the frequency of nutritional rickets among hospitalized infants and to assess their relation to respiratory diseases. All infants between the age of 3 months and 2 years admitted to the pediatric ward of Queen Alia Military Hospital during the period February-October 2001 were examined and investigated to rule out nutritional rickets. They concluded that rachitic infants are commonly hospitalized because of lower respiratory tract infections.¹⁶

Limitation: High prevalence of vitamin D deficiency in present study may be due to cut-off value for vitamin D level, that authors took for the study.

CONCLUSION

Vitamin D deficiency is common in children with LRTI especially among exclusively breastfed babies and children who were born preterm and not received supplements of vitamin D and among lower socio economic class. Vitamin D deficiency is also common in children with recurrent LRTI. Early recognition and

treatment of vitamin D deficiency can prevent morbidity associated with rickets and possibly frequent LRTI.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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