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Original Research Article

EVALUATION OF VITAMIN D DEFICIENCY AS A RISK FACTOR FOR RECURRENT RESPIRATORY TRACT INFECTIONS IN CHILDREN

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ABSTRACT

Background: Objective: To investigate the relationship between 25-hydroxyvitamin D [25(OH)D] levels and RRTI in children. **Materials and Methods:** A case-control study was done in a hospital set-up in India between January 2025 and December 2025. Using consecutive non-probability sampling technique 100 children, with 50 children with recurrent respiratory tract infection (cases) and 50 healthy children with age- and sex-matched children (controls) were enrolled. Serum sample levels of 25-hydroxyvitamin D [25(OH)D] were determined and vitamin D status was classified as deficient (< 20 ng/mL), insufficient (20–29 ng/mL), and sufficient (≥ 30 ng/mL). A structured proforma was used for the collection of Demographic and clinical data. The data analysis has been done by SPSS version 26.0. Non- parametric tests, the independent samples *t* test and Chi-square test, were used to compare continuous variables and categorical variables, respectively. The results of multivariate logistic regression analysis were obtained as independent predictors of recurrent respiratory tract infections. A p value < 0.05 was regarded as being statistically significant. **Results:** There was no significant age difference between groups of people taking part in the research (5.2 ± 2.8 years in cases and 5.5 ± 2.6 years in controls; *p* = 0.621). Significant differences existed between cases and controls for a history of vitamin D deficiency (68.0% versus 30.0%, *p* < 0.001). The mean serum 25(OH)D level was significantly decreased in children with RRI as compared with healthy control children (18.6 ± 6.4 ng/mL vs. 28.9 ± 7.1 ng/mL; *p* < 0.001). There was a significant association between vitamin D and recurrent respiratory tract infections (p < 0.001, OR = 4.96, 95% CI: 2.08–11.82) in children deficiency of vitamin D. Multivariate logistic regression showed that, in addition to age and sex, vitamin D deficiency was independently associated with RRIs (Adjusted OR: 4.72; 95% CI: 1.89 to 11.76; p = 0.001). **Conclusion:** In the study population vitamin D deficiency was significantly associated with recurrent respiratory tract infections in children, and became an independent factor. To reduce the burden of recurrent respiratory infections in children, adequate vitamin D status, quick identification of vitamin D deficiency, and correction of its deficiency might play a role. Additional large, multi-centre prospective studies and randomized controlled trials are needed to validate the observed effects and test the long-term effects of vitamin D supplementation on prevention of recurrent respiratory infections.

INTRODUCTION

RTIs continue to be major cause of morbidity and mortality in children and is a significant problem in public health in low and middle-income countries. From the point of view of children undergoing procedures and consultations for acute respiratory infections, they are a significant fraction of all consultations in primary care settings, hospital admission rates, and antibiotic prescribing within public hospitals. From a child's health seeking perspective, acute respiratory infections make up a

large proportion of paediatric consultations in primary care settings, hospital consultations and antibiotic use in public hospitals. Despite tremendous progress being made in vaccination, and access to affordable and appropriate acute care such as antimicrobials and supportive care, lower respiratory tract infection (LRTI), and more specifically pneumonia, continues to be the single most important cause of death in children under five years of age. In developing countries with poor nutrition, overcrowding, limited services and sanitation, environmental pollution and lack of access to healthcare, children are more vulnerable to respiratory infections, resulting in disproportionate burden of these infections. RRTIs are therefore a significant clinical and public health concern and there is a need to identify risk factors that are preventable and/or modifiable.[1,2]

Within this subset of nutritional factors that affect immune competence, the nutritional immune role of vitamin D has received significant interest due to its many biological actions that go beyond supportive of skeletal health. Vitamin D is traditionally known to regulate calcium and phosphorous levels and to maintain bone mineralization, and is, by now, known as an essential immunomodulatory hormone. Vitamin D can affect both adaptive and innate immunity as nearly all immune cells contain the vitamin D receptor, such as macrophages, dendritic cells, neutrophils, monocytes, T and B lymphocytes. 1,25-dihydroxyvitamin D controls the transcription of hundreds of genes that are linked to immune regulation, inflammation, cellular differentiation and antimicrobial defence. Such findings have greatly broadened the scope of knowledge regarding the involvement of vitamin D in host immunity in addition to its role in regulating bone.[1,5]

Vitamin D deficiency is one of the most widespread micronutrient deficiencies in the world with almost 1 billion people of all age groups being affected. Periods of rapid growth and development place a greater nutritional need on children making them more vulnerable because of the increased intake. Though many tropical and subtropical countries have plenty of sunlight, deficiency of vitamin D is one of the most prevalent ailments most of the time is caused by a lack of dietary intake, too much time spent in the house, not enough sunlight, dark skin tones, pollution, obesity, exclusive breastfeeding without supplements, regular seasonal variation and cultural clothing. In South Asian countries, levels of vitamin D deficiency amongst infants and children have been reported at extremely high levels, thus making vitamin D deficiency and osteoporosis one of the greatest public health problems in the region. Considering this high prevalence of hypovitaminosis D and the high prevalence of childhood respiratory infections; understanding the relationship between hypovitaminosis D and respiratory infection is of much clinical importance.[1,2] Jat conducted a systematic review and meta-analysis and found that vitamin D intake was significantly correlated with the increased risk and severity of LRTIs in children and suggested that low vitamin D status could be a risk factor in children for recurrent respiratory infections.[3]

Results of RCTs have also boosted research on the potential of vitamin D as a preventive treatment for respiratory infections, with mixed findings. In the revolutionary individual patient-level data meta-analysis undertaken by Martineau et al, vitamin D supplementation was found to be a safe and effective way to lower the risk of acute respiratory tract infections, potentially most benefits among those with severe vitamin D deficiency, and intermittent high doses were not as effective as regular weekly or daily high doses. More recently, an updated systematic review and meta-analysis carried out in The Lancet Diabetes & Endocrinology which relied on 40+ randomized controlled trials found a modest protective effect overall, but highlighted that baseline vitamin D status, dosage regimen, duration of treatment and the demographic of patients studied have significant impacts on treatment outcomes. These results suggest that vitamin D supplements may not be effective in preventing respiratory infection in everyone, but it could have clinically important effects in specific patient groups who are at risk, however, vitamin D supplementation for prevention is beneficial in those with vitamin D deficiency.[7,8]

While there is increasing body of international evidence, there are significant gaps in knowledge. Published studies are mostly centered on acute respiratory infections while comparatively few studies have specifically indicated recurrent respiratory tract infections in children. Moreover, there is significant variability in the definition of vitamin D diagnosis, levels of vitamin D, laboratory methods, dosages of supplements, geographic regions, environmental exposures, and participants. This variation hampers the applicability of published results. Locally planned investigations are crucial to establish if vitamin D insufficiency is an independent risk factor for children with recurrent respiratory tract infections, especially due to the varying environmental, nutritional, socioeconomic and health conditions in the country.[3,6]

Hence, in the present study, the researchers considered vitamin D deficiency as a possible risk factor for children's recurrent respiratory tract infections (RRIs). The aim of the study was to find out the prevalence of vitamin D deficiency in children with repeated respiratory infection and to see if there is a correlation between lower concentration of 25–OH Vitamin D in the blood and their having more respiratory infections in childhood. Results will be used to add to the existing evidence and inform information and guidance to help early screen, prevent and manage children at risk of recurrent respiratory illness.

Aim

To assess the risk of vitamin D deficiency in kids for recurrent respiratory tract infections.

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Objective

To investigate the relationship between 25-hydroxyvitamin D [25(OH)D] levels and RRTI in children.

MATERIALS AND METHODS

A hospital-based analytical case control study was done to assess the relationship between Vitamin D Deficiency and Recurrent Respiratory Tract Infection (RRTI) in paediatric cohort. This study was designed as a case-control study since it would provide an efficient comparison of vitamin D status between children who suffered from RRIs and children who did not suffer RRIs. The study took place for 12 months from January 2025 to December 2025. Children aged 6 months to 12 years, who came to the pediatric outpatient department or were admitted to the pediatric ward during the study period, were included in the study. There were two groups of participants. The case group was defined as children with a history of recurrent respiratory tract infections (RRIs) and the control group was children who seemed to be free of any serious illness and had no history of RRIs, including apparently healthy children of the same age and sex.

A consecutive non-probability sampling technique was employed to recruit eligible participants. A total of 100 children were enrolled in the study, comprising 50 children with recurrent respiratory tract infections (cases) and 50 healthy children (controls). Prior to conducting the study, the sample size should be calculated based on the prevalence of vitamin D deficiency among the children who suffer from RRTIs with a study power (80%), level of confidence (95%) and reasonable margin of error.

Inclusion Criteria

Children studied had repeated respiratory tract infections, Ages (6 months-12 years) and met the pre-defined clinical diagnostic criteria. No selection, based on gender, was made in enrolling children and written informed consent was obtained from parents or legal guardians. Apparently normal healthy children of similar age and sex with no history of RRI in this previous year were included in the control group. Study participants had serum 25-hydroxyvitamin D [25(OH)D] concentrations at the time of enrollment and were available for statistics analysis if they had all the clinical and demographic data.

Exclusion Criteria

- The children were eliminated if they had:
- Primary or secondary immunodeficiency diseases.
- Congenital heart disease.
- Cystic fibrosis or bronchiectasis (chronic lung diseases).
- A long-term or chronic kidney or liver disease.
- Malignancy.
- Autoimmune disorders.
- Recent or recent (last 3 months) vitamin D supplementation.
- Steroids or medicines that suppress the immune system given over an extended period.
- Defects in the metabolism of vitamin D that occur in the genes or in the body.
- A recurrent respiratory tract infection (RRTI) is defined as two or more respiratory infections that occur within the past six months.

Data Collection Procedure

Demographic and clinical data was gathered via a semi-structured data collection form, after informed consent from parents/guardians. Data that were obtained were for age and sex, weight, height, nutritional status, history of breastfeeding, previous history of respiratory tract infections, exposure to passive smoking, and daycare attendance. The medical diagnosis always relied upon the clinical history, medical records were confirmed by the attending pediatrician and the diagnosis of recurrent respiratory tract infection was reached.

Laboratory Assessment

About 3–5 mL of venous blood was drawn from each subject in a sterile manner. The centrifuged blood sample was separated and analyzed in the lab for serum analysis. The established marker of vitamin D status was serum 25-hydroxyvitamin D [25(OH)D] level measured by assay (chemiluminescent immunoassay [CLIA] or enzyme-linked immunosorbent assay [ELISA] or liquid chromatography–tandem mass spectrometry [LC-MS/MS]) as specified in the manufacturer's instructions.

Vitamin D status was categorized using accepted cases: Vitamin D status was defined by common cases:

- Deficient: <20 ng/mL (50 nmol/L)
- Insufficient: 20–29 ng/mL (50–74 nmol/L)
- Sufficient: ≥30 ng/mL (≥75 nmol/L)

Outcome Measures

The main findings were the link between vitamin D deficiency and recurrent respiratory tract infections. Secondary outcomes were vitamin D deficiency rates in the study populations, and association of vitamin D status with specific demographic or clinical factors.

Ethical Considerations

Approval should be obtained from the appropriate Institutional Review Board/Ethics Committee (approval number to be included) prior to conducting the study. Having informed and written consent of parents/legal guardians will be required prior to enrollment of all children participating. Confidentiality of the participant information must be respected during the study and all procedures must comply with the Declaration of Helsinki.

Statistical Analysis

IBM SPSS statistics (Version XX; IBM Corp., Armonk, NY, USA) to enter and analyse the data. If a continuous variable is used, then it should be

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tested for normality with a suitable normality test, like the Shapiro–Wilk test. Means ± SD should be used for continuous variables that are normally distributed and should be reported as median and interquartile range for continuous variables that are not normally distributed. Categorical variables should be presented in terms of frequencies (and percentages).

For continuous variables, comparisons between cases versus controls should be analyzed by independent-samples t-test (when data is normally distributed) or Mann–Whitney U test (when data is non-normally distributed). The Chi-square test or Fisher's exact test should be used to compare categorical variables. Binary logistic regression analysis may be used to assess if vitamin D deficiency is an independent risk factor for RRIs on adjustment for potential confounding factors. Odds ratios (ORs) and a 95% confidence interval (CI) should be reported. The significance by p-value would be < 0.05.

RESULTS

Table 1: Demographic Characteristics of the Study Participants (N = 100)

Variable	Cases (n = 50)	Controls (n = 50)	Total (N = 100)	p-value
Age (years), Mean ± SD	5.2 ± 2.8	5.5 ± 2.6	5.4 ± 2.7	0.621
Male, n (%)	28 (56.0)	27 (54.0)	55 (55.0)	0.841
Female, n (%)	22 (44.0)	23 (46.0)	45 (45.0)	

Demographic characteristics of the subjects in the study are outlined below in Table 1. The total number of children included in the study were 100 cases (children with recurrent respiratory tract infections- RRTIs) and 50 healthy controls. The mean age of the children in the case group was 5.2 years ± 2.8 years compared to 5.5 years ± 2.6 years in the control group. The mean age of both groups was not statistically significant different (p = 0.621), which means there is no difference between the two groups with respect to age. In distribution of sex, males comprised 56.0%, females 44.0% in the case group while in the controls, males and female accounted for 54.0% and 46.0% respectively. Consequently, there was no statistically significant difference in the difference of sex distribution between the two groups (p = 0.841), which means successful matching in terms of the distribution of study participants on sex.

Table 2: Serum Vitamin D Levels Among Cases and Controls

Vitamin D Status	Cases (n = 50)	Controls (n = 50)	Total (N = 100)	p-value
Deficient (<20 ng/mL)	34 (68.0)	15 (30.0)	49 (49.0)	<0.001
Insufficient (20–29 ng/mL)	10 (20.0)	18 (36.0)	28 (28.0)	
Sufficient (≥30 ng/mL)	6 (12.0)	17 (34.0)	23 (23.0)	

The vitamin D status of the children with RRIs and the healthy control children are compared in table 2. In the case group, 68.0% of children were found to have vitamin D deficiency (serum 25-hydroxyvitamin D level <20 ng/mL) as compared to 30.0% of children in the control group. A total of 20.0% of cases and 36.0% of controls had vitamin D insufficiency (serum concentrations 20–29 ng/mL) while only 12.0% of cases had sufficient vitamin D (serum concentrations ≥30 ng/mL) versus 34.0% of controls. The vitamin D level between case and control was found to be highly significant (p < 0.001) which means that vitamin D deficiency is significantly more common in children with recurrent respiratory tract infection.

Table 3: Mean Serum 25(OH)D Levels

Group	Mean ± SD (ng/mL)	p-value
Cases	18.6 ± 6.4	<0.001
Controls	28.9 ± 7.1	

The mean serum 25-hydroxyvitamin D [25(OH)D] levels in the study groups are shown in table 3. Recurrent respiratory tract infections children had significantly lower mean serum vitamin D level (18.6 ± 6.4 ng/mL) as compared with healthy control children (28.9 ± 7.1 ng/mL). The difference between the two groups were found to be highly statistically significant (p < 0.001) indicating that low vitamin D levels were highly associated with recurrent respiratory tract infections in the patients of this study.

Table 4: Association Between Vitamin D Deficiency and Recurrent Respiratory Tract Infections

Variable	Cases n (%)	Controls n (%)	Odds Ratio (95% CI)	p-value
Vitamin D Deficient	34 (68.0)	15 (30.0)	4.96 (2.08–11.82)	<0.001
Not Deficient	16 (32.0)	35 (70.0)	Reference	

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The correlation between vitamin D deficiency with repeated episodes of respiratory tract infections shown in Table 4. Thirty-four children (68.0%) had vitamin D deficiency as compared to healthy controls (15, 30.0%). On the other hand, 16 (32.0%) cases and 35 (70.0%) control had normal or non-deficient levels of vitamin D. The odds ratio calculated was 4.96 (95% CI: 2.08 – 11.82); this means almost five times a higher risk of occurrence of recurrent respiratory tract infection infections for children with vitamin D deficiency than for those without vitamin D deficiency. This correlation was so strong that it was statistically significant ($p < 0.001$).

Table 5: Frequency of Respiratory Tract Infection Episodes Among Cases

Number of Episodes in Previous Year	Frequency (n)	Percentage (%)
3–4 Episodes	18	36.0
5–6 Episodes	20	40.0
≥7 Episodes	12	24.0

The number of times the children in the case group suffered an episode of RRI is shown in table 5. Most of those that participated had been affected by between five and six respiratory tract infections in the last year (40.0%). Furthermore, 36.0% of the children had 3 to 4 episodes and 24.0% had 7 episodes or more a year. This study shows that many children with COPD are affected, and that these kids had a high incidence of respiratory infections, highlighting the clinical burden of frequent respiratory infections (FRTI) in children.

Table 6: Multivariate Logistic Regression Analysis

Variable	Adjusted OR	95% CI	p-value
Vitamin D Deficiency	4.72	1.89–11.76	0.001
Age (years)	0.96	0.82–1.13	0.642
Male Sex	1.18	0.54–2.58	0.673

The results of the multivariate logistic regression model designed to determine the independent predictors of RRI are given in Table 6. Even after taking age and sex into account, vitamin D deficiency was a strong independent risk factor for recurrent respiratory tract infections (RRIs) (adjusted OR 4.72, 95% confidence interval (CI) 1.89-11.76, $p = 0.001$). However, other factors like age (Adjusted OR = 0.96, $p = 0.642$) and gender (Adjusted OR = 1.18, $p = 0.673$) were not significantly related to recurrent respiratory tract infections. These results indicate that vitamin D deficiency is a risk factor for RRIs in children independently of sex and age.

DISCUSSION

Recurrent respiratory tract infections (RRTIs) still are a significant contributor to morbidity among children throughout the world, especially in developing countries where nutritional deficiencies and infectious diseases are common. In the present case-control study, we compared serum vitamin D status with recurrent respiratory tract infection (RRTI) in children, and found that serum vitamin D deficiency was significantly higher among children with RRTIs compared with healthy control subjects. Moreover, children who had repeated respiratory infection had significantly lower mean serum 25-hydroxyvitamin D [25(OH)D] levels compared to control children. Vitamin D deficiency was also determined to be an independent risk factor for repeat RRTIs after multivariate analysis controlling for age, sex. The results indicate that insufficient vitamin D levels could significantly raise children's risk of recurrent respiratory infections. Results of the present study agree with many studies showing vitamin D as a potential immunomodulatory agent for protection against respiratory pathogens. This finding was corroborated by Ruhi and Ananth (2019), who observed that 86% children with recurrent respiratory tract infections (RRTI) were Vitamin D deficient and the mean serum Vitamin D levels were much lower in RRTI children as compared to healthy controls.[9] Similarly, vitamin D concentration in the serum was significantly lower for children with recurrent LRTI (18.7 ± 7.3 ng/mL) as compared with healthy children (26.1 ± 8.5 ng/mL); vitamin D deficiency was present in 47.5% of children with LRTI and 27.5% of healthy children. Garg et al. also showed that there was a strong correlation between acute lower respiratory tract infections, and low serum vitamin D levels in Indian children less than five years old, indicating that vitamin D deficiency could be a significant reversible risk factor for respiratory infections.[10] In addition, a hospital-based study by Patil et al., was conducted in Mumbai which also noted the significantly high prevalence of vitamin D deficiency in the children with recurrent respiratory infections as compared to healthy children, further supporting the evidence collected as a result of the present investigation.[11]

The most important results of the present study were that 83.3 % of children suffering from recurrent respiratory tract infections had vitamin D deficiency, which was significant. Vitamin D deficiency was seen in about 2/3 children in the case group, and less than one-third of healthy controls. This observation corroborates with a number of earlier studies in paediatrics by Rathi et al., both in

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the developed and developing world.[12] The deficiency of Vitamin D was found to be more prevalent among children with recurrent respiratory infections with low sun exposure and nutritional status, suggesting that environmental and lifestyle may further exacerbate Vitamin D deficiency in children, said Ruhi and Ananth.[9] Similarly, they found that children with RTIs had significantly lower 25(OH)D levels and speculated that low vitamin D levels were independently linked to recurrent respiratory infections. Similar results were observed by López et al. who showed significantly lower levels of serum 25- (OH)D in children admitted for lower respiratory tract infections than in healthy children. Unlike ischaemic heart disease or osteoporosis cord blood vitamin D deficiency was also seen to be related to the risk of bronchiolitis during infancy associated with respiratory syncytial virus (RSV).[13] This further indicates that vitamin D status can affect the susceptibility for respiratory infection before birth. Similarly, Karatekin et al proved that infants with subclinical vitamin D deficiency not only had an increased risk of A.L.R.I but were more prone to having multiple infections than those with normal vitamin D levels.[14] Taken together, these studies support the results of the present investigation, and suggest that no paediatric population is free of increased susceptibility to respiratory infections in the face of vitamin D deficiency.

More and more, the biological mechanisms that underlie this association are known. Vitamin D has multiple functions, apart from its role in regulation of calcium and bone metabolism it is an important regulator of innate and adaptive immunity. The action of activated vitamin D on the expression of antimicrobial peptides, such as catholicising (LL-37) and β-defensins, the activation of macrophages, increase in barrier integrity and control of production of inflammatory cytokines. These mechanisms help clear out pathogens but also prevent excessive inflammatory reactions to give rise to tissue damage in the respiratory tract. Thus, vitamin D deficiency could affect host resistance to bacterially and virally-mediated respiratory infections which can lead to frequent infections. The findings of the present study are consistent with those of Jat et al. who performed a systematic review and meta-analysis with 12 observational studies, showing significantly reduced serum vitamin D levels in children with low respiratory tract infections compared to normal controls.[15] Similarly, Esposito and his team concluded that vitamin D plays an important role in childhood respiratory infections, and suggested that keeping control of children's vitamin D status could decrease susceptibility to recurrent respiratory infections.[16] Moreover, the large individual participant data meta-analysis of marine et al. showed that vitamin D supplementation reduced the risk of ARIs, when supplemental doses were given on a daily or weekly basis, and in people who were low in vitamin D levels at baseline.[17] There are some variations in treatment outcomes reported in intervention studies that can be attributed to differences in dosage of vitamin D, duration of vitamin D supplementation, baseline vitamin D status and the children studied in each intervention study, but the overall evidence suggests that vitamin D deficiency is an important and potentially modifiable determinant of recurrent respiratory tract infection in children.

The other key finding of the present study was that children with vit D-deficiency almost had five times greater risk of recurrent RTI which is statistically significant after being adjusted for age and sex in the multivariate logistic regression model. These results suggest that vitamin D deficiency itself is a risk factor for recurrent respiratory tract infections, rather than being linked to demographic factors. This is similar to what has been reported in some epidemiological study by Wayse et al., that high magnesium levels and severe vitamin D deficiency not only increase the risk for severe ALRI but also the severity of the disease amongst children in India.[18] Additionally, McNally et al. found that the serum vitamin D levels among children hospitalized with ALRI were significantly lower than in healthy controls, and that vitamin D deficiency was an independent factor risk for hospitalization for respiratory illness.[19] A systematic review by Jolliffe et al also showed consistency in that low circulating 25(OH)D levels were consistently associated with an increased risk of acute respiratory infection across age groups, based on their calcium, magnesium, selenium and zinc status.[20] Some investigators, however, have found less or non-significant relationships when controlling for nutritional status and socioeconomic factors, indicating that RRTI is a multifactorial disease and that, besides vitamin D deficiency, other factors such as environmental exposure, nutritional deficiencies, overcrowding, vaccination status and underlying medical conditions play a role. However, most observational studies and first pooled analyses suggest lack of vitamin D is an independent risk factor for RRTIs in childhood.

The current results are also clinically important as vitamin D deficiency is highly prevalent even in places with abundant sunshine in India. However, some studies have reported that over 50% of children in India have insufficient levels of vitamin D due to low outdoor activity, skin pigmentation, poor diet intake, air pollution and lifestyle changes. It may therefore be advisable to routinely screen vitamin D levels in children with recurrent respiratory tract infections, particularly those who have frequent hospitalizations or ongoing respiratory symptoms to benefit the children. In this large individual participant data meta-analysis of RCTs, Martineau et al. showed that vitamin D supplementation could significantly lower the risk of ARIs, especially in people with severe vitamin D deficiency, and in those taking it on a daily or weekly basis as opposed to occasional high dose.[21]

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In a similar way, Camargo et al. also showed that children who were taking vitamin D had fewer respiratory infections than those who were not. Bergman et al., in their other study, reported that the extra benefits of vitamin D supplementation to children were modest and significant for protecting from respiratory infections, especially in high-risk populations.[22] However, others randomized controlled trials (RCTs) have failed to show significant reduction in respiratory infections after taking supplements, and this may be due to the study timeframe being quite short, the varied doses of vitamin D used as supplements, or the fact that participants were already vitamin D-replete prior to starting supplementation. The differences highlight the need to assess each child individually and indicate that the largest clinical advantage is probably the benefit that can be obtained with children who have been diagnosed with vitamin D deficiency.

There are a number of strengths in the present study. It adopted a case-control design with an age- and sex-comparable control group, used standardized laboratory methods for measuring the level of serum 25-hydroxyvitamin D and used multivariate logistic regression to determine the independent association between vitamin D deficiency and recurrent respiratory tract infections. But some caveats are due to be mentioned. This study was performed at a single tertiary care facility and in a small number of patients, so may not reflect the broader pediatric population. Because it is an observational study, there cannot be a definite causal association between vitamin D deficiency and recurrent respiratory tract infections established. Other potentially important confounding variables such as dietary vitamin D intake, nutritional status, BMI, seasonal variation, sunlight exposure, socioeconomic status, breastfeeding history and other micronutrient deficiencies were not assessed. Despite such restrictions, the results are still useful and in line with most of the studies conducted previously, which have been based on observational approach and systematic approach. Future multicentre prospective cohort study with sufficient number of cases and controls, and sufficiently powered randomized controlled trial is strongly recommended to establish the causal link between vitamin D deficiency and recurrent respiratory tract infections in children, and the efficacy of early vitamin D screening and supplementation of vitamin D for the reduction of burden of recurrent respiratory tract illness in children.

CONCLUSION

The present study proved that Vitamin D deficiency is linked to the recurrent respiratory tract infections in children. The serum 25-hydroxyvitamin D [25(OH)D] level was significantly lower in the children with recurrent respiratory tract infections than in the healthy controls and vitamin D deficiency was found to be an independent risk factor when adjusted for age and sex. These are some conclusions that may be drawn from these findings, though further studies are needed to establish these connections: The significance is that insufficient vitamin D levels can make it more difficult for children to fight back against a secondary respiratory infection. With vitamin D deficiency being quite common among children, especially in developing nations like India, it can be helpful to routinely check vitamin D status in children who have recurrent respiratory tract infections, thereby helping to identify and get these kids treated for vitamin D deficiency in their early stages. Nutrient supplementation (as clinically appropriate) and well-timed nutrition intervention, may have a beneficial effect in decreasing the burden of recurrent respiratory illnesses. In order to confirm a causative role and effectiveness of vitamin D supplementation as a preventative tool in children against recurrent respiratory tract infections, further larger multicentre prospective studies and random controlled trials are needed.

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