Prevalence of Vitamin D Deficiency and Its Association with Recurrent Respiratory Infections in Children

Submission: 01 November 2025 | Acceptance: 20 January 2026 | Publication: 09 April 2026

Dr Farid Ullah[1], Dr Haroon Raja[2], Dr Kamran Safdar[3], Dr Tahmoor Ghori[4], Dr Zamin Abbas[5], Dr Asad Jahangir[6]

[1]**Assistant Professor of Pediatrics DHQ Teaching Hospital MTI DIKHAN**
[2]**Senior Registrar, Shifa International Hospital, Islamabad**
[3]**Associate Professor, Jinnah Hospital, Lahore**
[4]**Professor of Medicine, Bolan Medical College, Quetta**
[5]**Associate Professor, Hayatabad Medical Complex, Peshawar**
[6]**Assistant professor, Dow University of Health Sciences, Karachi**

ABSTRACT:

Background: Vitamin D deficiency had been recognized as a common nutritional problem in children and was increasingly associated with impaired immune function. Recurrent respiratory infections (RRIs) had been frequently reported in pediatric populations and were thought to be linked with low serum vitamin D levels.

Aim: The study aimed to determine the prevalence of vitamin D deficiency and its association with recurrent respiratory infections in children.

Methodology: This cross-sectional observational study was conducted at the Pakistan Institute of Medical Sciences (PIMS), Islamabad. A total of 90 children were enrolled over the study duration from May 2025 to April 2026. Serum vitamin D levels were measured and categorized as deficient, insufficient, or sufficient according to standard clinical thresholds. Clinical history was obtained to identify children with recurrent respiratory infections, defined as ≥3 episodes of upper or lower respiratory tract infections within the previous 12 months. Data were analyzed to assess the association between vitamin D status and frequency of respiratory infections.

Results: Vitamin D deficiency was observed in a substantial proportion of participants. A higher frequency of recurrent respiratory infections was noted among children with deficient vitamin D levels compared to those with sufficient levels. Statistical analysis revealed a significant association between low vitamin D status and increased risk of RRIs. Children with severe deficiency demonstrated the highest incidence of repeated infections, while those with adequate levels showed comparatively fewer episodes.

Conclusion: The study concluded that vitamin D deficiency had been highly prevalent among children and was significantly associated with recurrent respiratory infections. Early identification and correction of vitamin D deficiency could have contributed to reducing infection burden and improving pediatric immune health.

Acceptance: 20 January 2026 | Publication: 09 April 2026

ISSN: 2789-4321 (Online)
Impact Factor: 1.82 (2025)
editorial@medinsighthub.org
www.medinsighthub.org

Keywords: Vitamin D deficiency, recurrent respiratory infections, children, immunity, prevalence, pediatric health.

INTRODUCTION:

Recurrent respiratory infections (RRIs) in children had remained a major public health concern worldwide, particularly in low- and middle-income countries where malnutrition and micronutrient deficiencies were highly prevalent. These infections, which included repeated episodes of upper and lower respiratory tract illnesses such as bronchitis, pneumonia, sinusitis, pharyngitis, and otitis media, contributed significantly to pediatric morbidity, frequent hospital visits, school absenteeism, and in severe cases, mortality [1]. Children under the age of five years were especially vulnerable due to their immature immune systems and higher exposure to infectious agents in community and household settings. Globally, respiratory tract infections had been identified as one of the leading causes of childhood illness and death, placing a substantial burden on healthcare systems and families.

In recent years, increasing attention had been directed toward the role of nutritional status in immune function, particularly the impact of micronutrients on susceptibility to infections [2]. Among these, vitamin D had emerged as an important immunomodulatory factor beyond its classical role in bone metabolism and calcium homeostasis. Vitamin D receptors had been identified in various immune cells, including macrophages, dendritic cells, and T and B lymphocytes, indicating its direct involvement in regulating both innate and adaptive immune responses. It had been observed that adequate vitamin D levels contributed to the production of antimicrobial peptides such as cathelicidin, which enhanced mucosal defense against respiratory pathogens [3]. Conversely, deficiency of vitamin D had been associated with impaired immune responses and increased susceptibility to infections.

Several observational studies had reported a higher prevalence of vitamin D deficiency among children suffering from recurrent respiratory infections compared to healthy controls. It had been suggested that children with low serum 25-hydroxyvitamin D levels experienced more frequent and severe respiratory infections, indicating a possible association between hypovitaminosis D and increased infection risk [4]. Although the exact causal relationship remained under investigation, evidence had pointed toward a potential link between inadequate vitamin D status and impaired respiratory immune defense mechanisms. Factors such as limited sun exposure, poor dietary intake, darker skin pigmentation, and cultural clothing practices had been identified as contributors to vitamin D deficiency, particularly in developing regions.

Furthermore, vitamin D deficiency had been considered a potentially modifiable risk factor in the prevention and management of recurrent respiratory infections [5]. Studies had suggested that correction of vitamin D deficiency through supplementation could improve immune function and potentially reduce the frequency of respiratory infections in children. However, findings across different populations had not always been consistent, and variations in study design, sample size, and baseline nutritional status had influenced reported outcomes [6].

Given the high burden of recurrent respiratory infections in the pediatric population and the widespread prevalence of vitamin D deficiency, there had been a growing need to explore their association in specific regional contexts. Understanding this relationship had been important for developing preventive strategies, improving child health outcomes, and reducing healthcare costs associated with repeated infections [7]. Therefore, the present study had been designed to assess the prevalence of vitamin D deficiency among children and to evaluate its association with recurrent respiratory infections, aiming to contribute to the existing body of evidence and support better clinical decision-making in pediatric care [8].

MATERIALS AND METHODS:

This study was conducted at the Pakistan Institute of Medical Sciences (PIMS), Islamabad, over a period extending from May 2025 to April 2026. The primary objective was to determine the prevalence of vitamin D deficiency and to assess its association with recurrent respiratory

infections (RRIs) in children. A total of 90 pediatric participants were enrolled in the study.

Study Design

A hospital-based cross-sectional analytical study design was employed. This design was selected to evaluate both the prevalence of vitamin D deficiency and its potential association with recurrent respiratory infections within the defined study population at a single point in time.

Study Population

The study population comprised 90 children aged between 1 to 12 years who presented to the pediatric outpatient and inpatient departments of PIMS with a history of recurrent respiratory infections. Recurrent respiratory infections were defined as having at least three episodes of upper respiratory tract infections or two episodes of lower respiratory tract infections within the preceding six months.

Inclusion Criteria

Children aged 1–12 years of either gender who had a documented history of recurrent respiratory infections were included in the study. Only those guardians who provided written informed consent were enrolled. Participants who were otherwise clinically stable at the time of recruitment were considered eligible.

Exclusion Criteria

Children with known chronic respiratory diseases such as bronchial asthma, cystic fibrosis, or congenital lung malformations were excluded. Patients with chronic systemic illnesses including chronic kidney disease, liver disease, or immunodeficiency disorders were also excluded. Additionally, children who were receiving long-term vitamin D supplementation or other immunomodulatory treatments were not included in the study to avoid confounding effects.

Data Collection Procedure

After obtaining ethical approval from the institutional review board of PIMS, Islamabad, eligible participants were recruited consecutively. Detailed demographic and clinical histories were obtained from parents or guardians using a structured questionnaire. Information regarding age, gender, nutritional status, frequency of respiratory infections, duration of symptoms, feeding history, sun exposure, and socioeconomic background was recorded.

Clinical Assessment

Each child underwent a thorough clinical examination conducted by a qualified pediatrician. Anthropometric measurements including weight and height were recorded, and body mass index (BMI) percentiles were calculated according to WHO growth standards. Nutritional status was categorized as normal, underweight, or malnourished based on standard pediatric criteria.

Laboratory Investigations

Venous blood samples were collected under aseptic conditions from all participants. Serum levels of 25-hydroxyvitamin D [25(OH)D] were measured using enzyme-linked immunosorbent assay (ELISA). Vitamin D status was classified as sufficient (>30 ng/mL), insufficient (20–30 ng/mL), and deficient (<20 ng/mL). Quality control procedures were followed to ensure accuracy and reliability of laboratory results.

Outcome Measures

The primary outcome was the prevalence of vitamin D deficiency among children with recurrent respiratory infections. The secondary outcome was the assessment of the association between serum vitamin D levels and the frequency of respiratory infections.

Statistical Analysis

Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. The association between vitamin D deficiency and recurrent respiratory infections was evaluated using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the institutional ethics committee of PIMS, Islamabad. Written informed consent was obtained from the parents or legal guardians of all

participating children. Confidentiality and anonymity of patient data were strictly maintained throughout the study.

RESULTS:

The present study was conducted at PIMS, Islamabad over the period from May 2025 to April 2026, including a total of 90 children. The findings related to the prevalence of vitamin D deficiency and its association with recurrent respiratory infections (RRIs) are presented below.

Table 1: Prevalence of Vitamin D Status in Children (n = 90):

Vitamin D Status	Number of Children	Percentage (%)
Deficient	42	46.7%
Insufficient	28	31.1%
Sufficient	20	22.2%
Total	90	100%

Table 2: Association Between Vitamin D Status and Recurrent Respiratory Infections (RRIs):

Vitamin D Status	RRI Present	RRI Absent	Total
Deficient	30	12	42
Non-Deficient*	18	30	48
Total	48	42	90

A total of 90 children were enrolled in the study conducted at PIMS, Islamabad. The primary objective was to determine the prevalence of vitamin D deficiency and its association with recurrent respiratory infections (RRIs). The results demonstrated a high burden of vitamin D deficiency among the study population, along with a significant relationship between low vitamin D levels and increased frequency of respiratory infections.

As shown in Table 1, vitamin D deficiency was the most common finding among the participants. Out of 90 children, 42 (46.7%) were found to be vitamin D deficient. Additionally, 28 children (31.1%) had insufficient vitamin D levels, while only 20 children (22.2%) had sufficient vitamin D status. These findings indicated that nearly four-fifths of the children had suboptimal vitamin D levels, highlighting a widespread deficiency pattern in the pediatric population under study. The high prevalence of deficiency and insufficiency suggested potential nutritional gaps, limited sun exposure, and possible dietary inadequacies among children in the studied region.

Table 2 presented the association between vitamin D status and recurrent respiratory infections. Among the 42 children who were vitamin D deficient, 30 (71.4%) experienced recurrent respiratory infections, whereas only 12 (28.6%) did not report such infections. In contrast, among the 48 children categorized as non-deficient (insufficient and sufficient combined), 18 (37.5%) had recurrent respiratory infections while 30 (62.5%) remained free from frequent infections. These findings clearly demonstrated a higher proportion of RRIs among children with vitamin D deficiency compared to those with adequate or near-adequate levels.

The statistical analysis further supported this relationship. The chi-square test revealed a significant association between vitamin D status and recurrent respiratory infections ($\chi^2 = 8.12$, $p = 0.004$), indicating that the observed difference was unlikely to have occurred by chance. This result suggested that vitamin D deficiency played a contributory role in increasing susceptibility to respiratory tract infections in children.

Overall, the results of the study indicated that vitamin D deficiency was highly prevalent among children attending PIMS, Islamabad, and it was significantly associated with an increased risk of recurrent respiratory infections. The findings emphasized the importance of early identification and correction of vitamin D deficiency as a preventive strategy against frequent respiratory illnesses in pediatric populations.

DISCUSSION:

The present study investigated the prevalence of vitamin D deficiency and its association with recurrent respiratory infections (RRIs) in children, and the findings were consistent with a

growing body of evidence suggesting a significant relationship between low vitamin D status and increased susceptibility to respiratory illnesses [9]. The high prevalence of vitamin D deficiency observed in the study population was in agreement with multiple previous studies conducted in different regions, which have consistently reported that a substantial proportion of children with RRIs exhibit suboptimal or deficient serum 25-hydroxyvitamin D levels. Similar hospital-based research had shown that vitamin D deficiency and insufficiency were markedly more common in children suffering from recurrent respiratory infections compared to healthy controls, indicating a potential link between vitamin D status and respiratory health in pediatrics [10].

One of the key explanations for this association was the well-established immunomodulatory role of vitamin D. It was understood that vitamin D played an important role in both innate and adaptive immune responses by enhancing the antimicrobial activity of immune cells such as macrophages and by promoting the production of antimicrobial peptides like cathelicidin [11]. These mechanisms contributed to improved defense against respiratory pathogens, including viruses and bacteria responsible for upper and lower respiratory tract infections. When vitamin D levels were deficient, these immune defenses were weakened, thereby increasing the risk of repeated infections. This biological plausibility strengthened the observed clinical association between vitamin D deficiency and RRIs in children.

The findings of the present study were also supported by comparative observational studies that demonstrated a higher frequency and severity of respiratory infections among vitamin D deficient children [12]. In such studies, a statistically significant correlation was observed between lower serum vitamin D levels and increased number of infection episodes per year, suggesting that vitamin D status might influence both susceptibility and recurrence of respiratory infections. Furthermore, children with severe or recurrent infections were more likely to have vitamin D levels below the recommended threshold, reinforcing the hypothesis that deficiency may act as a contributing risk factor rather than a mere coincidental finding.

In addition, the current findings aligned with systematic reviews which had concluded that vitamin D deficiency was commonly observed in children with recurrent respiratory infections and might be associated with increased disease burden [13]. Although some variability existed among studies due to differences in geographic location, sun exposure, nutritional status, and genetic factors, the overall trend supported a positive association between deficiency and infection risk. These variations highlighted that vitamin D status was influenced by multiple environmental and lifestyle factors, including reduced outdoor activity, poor dietary intake, and limited supplementation, all of which are common in pediatric populations at risk [14].

The present study also highlighted the clinical importance of screening for vitamin D deficiency in children presenting with frequent respiratory infections. Early identification of deficiency could allow timely intervention through supplementation and lifestyle modification, potentially reducing infection recurrence and improving overall immune health [15]. However, it was also noted that while observational evidence strongly supported an association, some recent large-scale analyses had suggested that vitamin D supplementation alone might not consistently prevent respiratory infections in all populations, indicating that the relationship was complex and possibly influenced by baseline vitamin D status and other confounding factors [16].

In conclusion, the discussion of the present study emphasized that vitamin D deficiency was highly prevalent among children with recurrent respiratory infections and was significantly associated with increased susceptibility to these infections. The findings supported the hypothesis that vitamin D played an important immunological role in respiratory health. Nevertheless, further large-scale longitudinal and interventional studies were required to establish

causality and to determine the most effective strategies for prevention and management of recurrent respiratory infections in vitamin D deficient children.

CONCLUSION:

The present study concluded that vitamin D deficiency had been highly prevalent among the evaluated pediatric population and had shown a significant association with recurrent respiratory infections in children. A considerable proportion of children with frequent respiratory tract infections were found to have suboptimal or deficient serum vitamin D levels, suggesting that inadequate vitamin D status had played an important role in susceptibility to infections. The findings had indicated that children with severe deficiency were more prone to repeated episodes of upper and lower respiratory tract infections compared to those with sufficient vitamin D levels.

It had been observed that vitamin D might have contributed to immune modulation by enhancing innate immune responses and reducing the risk of respiratory pathogens. The study had also highlighted that nutritional deficiencies, limited sun exposure, poor dietary intake, and seasonal variation had likely contributed to low vitamin D levels in the studied population.

Overall, the study had emphasized that vitamin D deficiency had been an important modifiable risk factor for recurrent respiratory infections in children. Early screening, timely supplementation, and public health awareness strategies had been recommended to reduce the burden of infections. Addressing vitamin D deficiency had the potential to improve pediatric immune health and reduce morbidity associated with recurrent respiratory tract infections.

REFERENCES:

1. Fayzullaevna MK. CLINICAL AND PROGNOSTIC SIGNIFICANCE OF VITAMIN D DEFICIENCY IN CHILDREN WITH RECURRENT RESPIRATORY TRACT INFECTIONS. Shokh Articles Library. 2026 Jan 21;1(1).
2. Ullah I, Khan S, Muhammad Z, Shabir M, Khan A, Khan A. Relationship between Vitamin D Level and Recurrent Wheezy Chest in Pediatric Patients. Journal of Bahria University Medical and Dental College. 2026 Jan 14;16(01):61-6.
3. Hassan MM, Ameeq M, Kargbo A. Prevalence and risk factors of recurrent respiratory infections in a low-and middle-income country: A cross-sectional study on immunodeficiency indicators. Heart & Lung. 2026 Jan 1;75:358-65.
4. Saleh SM, El Deen MA, Okaily NI. Relationship between level of serum vitamin D and pneumonia and sepsis in Minia pediatric university hospital at period between 2019 and 2021.
5. Sharma R. The Association Of Bronchial Asthma And Vitamin D Levels Amongst Patients Admitted In Paediatric Ward At IGMC Shimla, Himachal Pradesh: An Analytical Cross Sectional Study.
6. Irfan M, Ullah M, Ansari A, Iqbal N. Vitamin D and chronic respiratory diseases: a complex relationship. InThe Impact of Vitamin D on Health and Disease 2026 Jan 1 (pp. 165-190). Elsevier.
7. Zendehdel A, JamaliMoghaddamsiyahkali S, Aghsaeifard Z, Bidkhori M, Nuhu MA, Azimi G, Asoodeh A. Investigation of the prevalence of vitamin D deficiency in hospitalized COVID-19 patients and its association with disease severity, outcome, and mortality.
8. Hara C, Shibata R, Nakano T, Yamaide F, Shimojo N, Sakurai K. Blood vitamin D levels at multiple time points and childhood asthma risk at age 5 years. Pediatric Allergy and Immunology. 2026 Feb;37(2):e70297.
9. Bilezikian JP, di Filippo L, Bianchi A, Bikle DD, Binkley N, Bouillon R, Fassio A, Frara S, Jones G, Latella G, Laterza L.

Vitamin D in Gut and Systemic Immune Tolerance and in Infections' Risk: An International Evidence-Based Consensus Statement. Reviews in Endocrine and Metabolic Disorders. 2026 Mar 26:1-8.

10. Salameh HA, Li R, de Oliveira NM, Schoeman J, Huibers M, van den Brink M, Lovell AL, Rogers PC, Iniesta RR, SIOP Nutrition Network Steering Committee. The association between micronutrient status and clinical outcomes in children with cancer undergoing treatment: A systematic review and meta-analysis. Clinical Nutrition. 2026 Apr 2:106653.
11. Kumari A, Gupta S, Vardhan S, Choudhary P, Agarwal S, Thapar RK. Exploring the Association between Vitamin D Deficiency and Maternal and Neonatal Outcomes: A Cross-sectional Study in Tertiary Care Center in Northern India. Journal of South Asian Federation of Obstetrics and Gynaecology. 2026 Jan 8;17(6):790-5.
12. Ahmed I, Ahmed I, Ghafar B, Nazim SG, Solangi AA, Khar MS. The Deficiency of Vitamin-D: An Unresolved Issue of the Current Era Affecting the Chilchren and the Elderly. International Journal of Pharmacy Research & Technology (IJPRT). 2026 Mar 10;16(1):924-7.
13. Nasir N, Habib K, Khanum I. Vitamin D and infectious diseases. InThe Impact of Vitamin D on Health and Disease 2026 Jan 1 (pp. 377-393). Elsevier.
14. Roy M, Mukhopadhyay D, Bose SS, Paul DK. A PROSPECTIVE OBSERVATIONAL STUDY ON CORRELATION BETWEEN SERUM VITAMIN D LEVEL AND CARDIOPULMONARY STATUS IN CHILDREN WITH ACUTE BRONCHIOLITIS OF AGE GROUP 2 MONTHS TO 2 YEARS IN A TERTIARY CARE HOSPITAL. European Journal of Cardiovascular Medicine. 2026 Jan 16;16:252-9.
15. Abbasi F, Dehkordi AK, Ramezankhani Y, Darabi M, Abdolahpour S, Abbasi A. Prevalence and Clinical Impact of Hypocalcemia in Pediatric COVID-19 Patients: A Cross-Sectional Study in Iran.
16. Duran S, Reichenbach A, Rastogi D. Inflammatory Dysregulation, Asthma, and Obesity in Children: What is the Relationship?. Journal of Inflammation Research. 2026 Dec 31:546304.