DOI: https://doi.org/10.54393/pjhs.v6i11.3187

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 6, Issue 11 (November 2025)

Original Article

OPEN ACCESS

Prevalence and Risk Factors of Vitamin D Deficiency in Children Aged 0–5 Years: A Cross-Sectional Study in Khairpur District, Sindh

Ubedullah Bahalkani[1], Mumtaz Ali Bharo[2], Asif Ali Khuro[3], Pardeep Kumar[3], Muhammad Zaki[2] and Iftikhar Haider Shah[3]

[1]Department of Pediatrics, Khairpur Medical College, Khairpur, Pakistan
[2]Department of Pediatrics, Ghulam Muhammad Mahar Medical College, Sukkur, Pakistan
[3]Department of Pediatrics, Pir Abdul Qadir Shah Jeelani Institute of Medical Sciences, Gambat, Pakistan

ARTICLE INFO

Keywords:
Vitamin D Deficiency, Early Childhood, Prevalence, Risk Factors, Sindh, Prevention

How to Cite:
Bahalkani, U., Bharo, M. A., Khuro, A. A., Kumar, P., Zaki, M., & Shah, I. H. (2025). Prevalence and Risk Factors of Vitamin D Deficiency in Children Aged 0–5 Years: A Cross-Sectional Study in Khairpur District, Sindh: Risk Factors of Vitamin D Deficiency in Sindh's Children. Pakistan Journal of Health Sciences, 6(11), 64-68. https://doi.org/10.54393/pjhs.v6i11.3187

***Corresponding Author:**
Ubedullah Bahalkani
Department of Pediatrics, Khairpur Medical College, Khairpur, Pakistan
ubedullahdr@yahoo.com

Received Date: 18th May, 2025
Revised Date: 5th November, 2025
Acceptance Date: 14th November, 2025
Published Date: 30th November, 2025

ABSTRACT

Vitamin D insufficiency is a major public health concern among young children, leading to skeletal deformities and impaired immune function. Limited sunlight exposure, poor diet, and low socioeconomic status contribute significantly to its burden in developing regions. **Objectives:** To determine the prevalence, risk factors, clinical manifestations, and health outcomes of vitamin D deficiency in children aged 0–5 years in Sindh, and to develop evidence-based strategies for its prevention and management. **Methods:** This cross-sectional analytical study was conducted at Khairpur Medical College, Khairpur Mir's, Sindh, over six months (September 2024–February 2025). A total of 500 children were assessed for serum vitamin D levels and categorized as deficient (<20 ng/mL), insufficient (20–30 ng/mL), or sufficient (>30 ng/mL). Data on sunlight exposure, dietary intake, and socioeconomic factors were collected. Clinical manifestations, including growth retardation, dental issues, muscle weakness, and respiratory problems, were documented. Statistical analysis employed chi-square and logistic regression tests. **Results:** Vitamin D deficiency was observed in 50% of participants, while 29% had insufficiency. Key predictors included inadequate sunlight exposure (<30 minutes/day), poor dietary intake (OR=5.6, p<0.001), and low socioeconomic status (OR=4.3, p=0.002). Rickets (32.7%), recurrent respiratory infections (30.9%), delayed tooth eruption (29.1%), and muscle weakness (27.3%) were common findings. **Conclusions:** Vitamin D deficiency is highly prevalent among children in Sindh, with significant clinical and health implications. Public health initiatives promoting vitamin D supplementation, nutrition education, and sunlight exposure are urgently needed.

INTRODUCTION

Vitamin D acts as a central fat-soluble vitamin needed by young children for their bone health and immune system development. Vitamin D helps the body absorb calcium and phosphorus from the diet to create strong bones and supports muscle movement, as well as normalizes nerve impulses and protects against infections [1, 2]. Vitamin D deficiency continues to be a common nutritional problem in young children of developing nations, including Pakistan. A lack of vitamin D causes major health risks, including deformed bones, slow growth, repeated infections, and higher risk of chronic diseases during adulthood [3, 4]. As the largest province of Pakistan, Sindh has many types of people who face different health situations because of their lifestyle beliefs and how they consume food. Young children suffer more from vitamin D deficiency as they spend little time in sunshine, and parents do not provide enough vitamin D through food or educate themselves about this issue [5]. Changes in lifestyle habits and reduced UVB light availability because of pollution make it harder for children in urban settings to obtain the required vitamin D levels through daily activities. Malnutrition, together with poverty and cultural clothing that stops sun contact, creates high vitamin D shortage rates in young children, which need rapid public healthcare responses [6]. Children

DOI: https://doi.org/10.54393/pjhs.v6i11.3187

with vitamin D shortage between birth to age 5 show symptoms like rickets and delayed tooth development in their bones, plus weakened muscles alongside poor growth and weaker immune function [7, 8]. Lower vitamin D amounts lessen a child's immune response to infections because they get sick more often. Studies link vitamin D deficiency to brain disorders and diminished cognitive performance as well as raise the chance of developing type 1 diabetes and asthma in adult life. The lack of vitamin D creates direct health risks plus adds heavy costs to the healthcare system [9]. Families and health services should pay costs when children develop rickets symptoms and recurrent infections because they need consistent medical appointments and extended nursing care. Official healthcare organizations in the pediatric department still do not test patients regularly for vitamin D deficiency, while awareness about its treatment and prevention remains weak in many community areas [10]. While global research has highlighted the significance of vitamin D deficiency, there is a lack of comprehensive studies focusing specifically on children under five years of age in Sindh. Most local research has concentrated on older children or adults, leaving a knowledge gap about the unique risk factors and clinical manifestations in this vulnerable age group.

This study aimed to determine the prevalence, risk factors, clinical manifestations, and health outcomes of vitamin D deficiency in children aged 0–5 years in the Khairpur district of Sindh, to develop localized, evidence-based strategies for prevention and management.

METHODS

This cross-sectional analytical study was conducted over six months from September 2024 to February 2025 at the Pediatric department in Khairpur Medical College, Khairpur Mir's Sindh. Ethical approval was obtained from the Institutional Review Board of Khairpur Medical College, Khairpur Mir's Sindh (Ref. No. KMC/RERC/116). Informed written consent was secured from parents or guardians. The researchers gather data from parents and guardians about 0-5-year-old children living in different parts of society. The minimum required sample size was calculated using the WHO sample size calculator for prevalence studies, the single population proportion formula: $n=Z2\times p\times(1-p)d2$ Where: n = required sample size, Z=1.96 (standard normal value for 95% confidence interval), p=expected prevalence of vitamin D deficiency (assumed 50% from previous regional studies to ensure maximum sample size), d= margin of error (5% or 0.05) [11]. To account for a 20% non-response rate, the final sample size was increased to 500 participants. Our study participants were using a stratified random sampling technique. The sample size was calculated using the WHO sample size calculator for prevalence studies, with a 95% confidence level and a 5% margin of error. The study participants must live in Sindh for half a year before enrolment, and their parents need to sign consent forms. Vitamin D study participants were not including children with genetic bone diseases or metabolic issues, had not used past vitamin D supplement for three months or more, and significant health problems affecting bone development. Data were collected through a structured and standardized process to ensure accuracy and reliability. A structured questionnaire was administered to parents or caregivers to obtain detailed information regarding demographic characteristics, socioeconomic status, dietary habits, breastfeeding history, and daily sun exposure. The questionnaire was pre-tested on 10% of the study population before the main survey to ensure clarity, validity, and reliability of responses. A clinical examination was then performed by two trained pediatricians using a standardized checklist to identify common clinical manifestations associated with vitamin D deficiency, including rickets, muscle weakness, and delayed teething. Inter-observer reliability between the two examiners was assessed using the kappa statistic, which yielded a coefficient of 0.82, indicating a high level of agreement. For the laboratory assessment, 2–3 mL of venous blood was collected from each child by a certified phlebotomist under aseptic conditions. All samples were transported under a maintained cold chain and analyzed within 24 hours using a chemiluminescent immunoassay (CLIA) to measure serum 25-hydroxyvitamin D [25(OH)D] levels. Both internal and external quality control measures were strictly followed according to ISO 15189 laboratory standards to ensure the precision and accuracy of results. To ensure clarity and reproducibility, all key variables were explicitly defined. Vitamin D status, the primary outcome variable, was categorized based on serum 25-hydroxyvitamin D [25(OH)D] levels measured using a chemiluminescent immunoassay (CLIA) in a standardized laboratory. Children with serum 25(OH)D levels below 20 ng/mL were classified as vitamin D deficient, those with levels between 20–30 ng/mL were considered insufficient, and those with levels above 30 ng/mL were regarded as sufficient in vitamin D status. Data were analyzed by using SPSS 23.0. Descriptive Statistics: Frequencies and percentages were used to summarize categorical variables. Inferential Statistics: Chi-square test was used to assess associations between categorical variables. Multivariate logistic regression was performed to identify independent predictors of vitamin D deficiency. Results were reported as adjusted odds ratios (AOR) with 95% confidence intervals (CI). Significance Level: A p-value <0.05 was considered statistically significant.

DOI: https://doi.org/10.54393/pjhs.v6i11.3187

RESULTS

The study found that 55% of children aged 0–5 years in Sindh were vitamin D deficient, with serum 25(OH)D levels below 20 ng/mL. Additionally, 29% of children had insufficient vitamin D levels (20–30 ng/mL), while only 16% had sufficient levels (>30 ng/mL). These findings indicate a high burden of vitamin D deficiency in early childhood, highlighting the need for targeted interventions such as supplementation and dietary modifications see table 1.

Table 1: Prevalence of Vitamin D Deficiency in Children (n=500)

Vitamin D Status	Serum 25(OH)D Level (ng/mL)	Frequency (%)
Deficient	<20	275 (55.0%)
Insufficient	20–30	145 (29.0%)
Sufficient	>30	80 (16.0%)
Total	–	500 (100.0%)

Infants aged 0–1 year had the highest prevalence of vitamin D deficiency (62.5%), followed by children aged 1– years (52.6%) and 3–5 years (52.6%). A statistically significant association was found between younger age and deficiency ($p < 0.05$). Vitamin D deficiency was slightly higher in females (56.3%) compared to males (53.8%), though this difference was not statistically significant ($p=0.12$)(Table 2).

Table 2: Distribution of Vitamin D Deficiency by Age and Gender

Category	Total (n=500)	Deficient (n=275)	Insufficient (n=145)	Sufficient (n=80)	p-value
Age Group 0–1 yrs	120	75 (62.5%)	30 (25.0%)	15 (12.5%)	<0.05*
Age Group 1–3 yrs	190	100 (52.6%)	60 (31.6%)	30 (15.8%)	<0.05*
Age Group 3–5 yrs	190	100 (52.6%)	55 (28.9%)	35 (18.4%)	<0.05*
Male	260	140 (53.8%)	80 (30.8%)	40 (15.4%)	0.12
Female	240	135 (56.3%)	65 (27.1%)	40 (16.6%)	0.12

Low sun exposure (<30 minutes/day) was the strongest predictor of vitamin D deficiency, present in 76.4% of deficient children compared to 25.0% of those with sufficient levels (OR=8.1, $p<0.001$). Poor dietary intake of vitamin D-rich foods (low consumption of dairy, fish, eggs) was also a significant risk factor (OR=4.3, $p<0.01$). Children from lower socioeconomic backgrounds (OR=2.4, $p<0.05$) and those with less-educated parents (OR = 2.3, $p<0.05$) had a significantly higher risk of deficiency (Table 3).

Table 3: Risk Factors Associated with Vitamin D Deficiency

Category	Deficient (n=275)	Insufficient (n=145)	Sufficient (n=80)	OR (95% CI)	p-value
Low Sun Exposure (<30 min/day)	210 (76.4%)	50 (34.5%)	20 (25.0%)	8.1 (4.5–14.6)	<0.001**
Poor Dietary Intake	180 (65.4%)	40 (27.6%)	25 (31.3%)	4.3 (2.6–7.2)	<0.01*
Low Socio-economic Status	160 (58.2%)	45 (31.0%)	30 (37.5%)	2.4 (1.5–4.1)	<0.05*
Parental Education < High School	140 (50.9%)	38 (26.2%)	25 (31.3%)	2.3 (1.4–3.9)	<0.05*

Children with vitamin D deficiency had significantly higher rates of rickets (32.7%), delayed teething (29.1%), muscle weakness (27.3%), and frequent respiratory infections (30.9%) compared to those with sufficient vitamin D levels (Table 4).

Table 4: Clinical Manifestations and Health Outcomes of Vitamin D Deficiency

Category	Deficient n (%)	Insufficient n (%)	Sufficient n (%)	p-value
Rickets	90 (32.7%)	20 (13.8%)	5 (6.3%)	<0.001**
Delayed Teething	80 (29.1%)	18 (12.4%)	10 (12.5%)	<0.05*
Muscle Weakness	75 (27.3%)	15 (10.3%)	8 (10.0%)	<0.01*
Frequent Respiratory Infections	85 (30.9%)	22 (15.2%)	12 (15.0%)	<0.01*

The research found that limited sun exposure created the greatest risk of vitamin D shortage among young children since it raised the likelihood sevenfold (OR: 7.5). Participants who did not consume enough foods with vitamin D had a fourfold greater chance of developing deficiency according to our study results. Children facing economic hardship had double the chance of vitamin D insufficiency because they lacked quality food and outdoor time. People with parents having less education were more likely to develop vitamin D deficiency (OR: 2.1, 95% CI: 1.2-3.6, $p < 0.05$), so awareness programs about vitamin D benefits are needed for this group. Participants who exercise for under one hour daily have no increased risk of vitamin D deficiency (OR: 0.5, 95% CI: 0.3, $p = 0.09$) since insufficient sun contact outperforms exercise as a real risk factor (Table 5).

Table 5: Multivariate Logistic Regression Analysis of Risk Factors for Vitamin D Deficiency

Variables	Adjusted OR (95% CI)	p-value
Low Sun Exposure	7.5 (4.2–13.5)	<0.001**
Poor Dietary Intake	4.1 (2.4–6.9)	<0.01*
Lower Socioeconomic Status	2.2 (1.3–3.8)	<0.05*
Parental Education < High School	2.1 (1.2–3.6)	<0.05*
Physical Activity <1 hr/day	0.8 (0.5–1.4)	0.09

DISCUSSIONS

Our research reveals important details about the extent and causes of vitamin D deficiency and its health effects in children. One in every two children in this age range shows vitamin D deficiency, while an additional 29% suffer from insufficient vitamin D levels. South Asian pediatric research has consistently shown that vitamin D deficiency affects between 6% and 70% of our study participants [12]. The number of vitamin D-deficient children in our study population is slightly more than what western nations report for their regions, which frequently adds vitamin D to food supplies, while patients know about supplements through awareness campaigns [13]. Our findings show

DOI: https://doi.org/10.54393/pjhs.v6i11.3187

multiple risk factors affect vitamin D levels, with spending less than half an hour in the sun every day standing out as the main problem. Our study confirms that stopping daily sun exposure stands out as the clearest predictor in developing vitamin D deficiency (OR=8.1, p<0.001), like what other studies from Pakistan and Saudi Arabia found in relation to cultural and safety practices [14, 15]. Previous research shows that children from low-income families develop vitamin deficiency problems mostly because they lack proper access to nutritious dairy products and fortified foods. Research shows that vitamin D deficiency levels depend on how much parents understand about the source of this nutrient and what they teach their children about it [16, 17]. The findings from this research match global knowledge about vitamin D deficiency by showing rickets in 32.7% of patients, alongside 29.1% delayed tooth growth and physical weakness (27.3%), with 30.9% experiencing respiratory infections often. Research in India discovered that 30% of children with vitamin D insufficiency were themselves physically affected by rickets, showing the serious issue in developing nations [18]. Studies worldwide confirm that youngsters who have lower vitamin D levels experience 1.8 more respiratory infections compared to others. The research demonstrates that vitamin D helps protect our immune system and promotes healthy bone growth, according to medical research and clinical experiments [19]. The medical community should create initiatives to prevent vitamin D deficiency by recommending supplements and healthy eating, as well as advancing education on safe sun practices. Scandinavian research shows that food fortification helps pediatric patients reach less than 10% vitamin D deficiency levels, which suggests this strategy would work well for Sindh's children [20]. In limitation, Vitamin D changes from season were not controlled, which may have affected the study findings. Parents share their children's food information, yet reporting errors tend to happen in responses. More research with both ongoing observations and testing of prevention plans is necessary to study this topic better.

CONCLUSIONS

In conclusion, many children aged 0–5 in Sindh suffer from vitamin D deficiency, and this problem strongly connected with less sunlight exposure and poorer eating choices among low-income families. The risky health outcomes, such as rickets and infections, support the urgency for medical response. Eating better food and proper vitamin D supplementation must become a regional priority to improve child health in Sindh. Studies should examine vitamin D changes throughout the year and investigate if genetic factors and long-term health effects impact children to create effective protection plans for early vitamin D deficiency.

Authors Contribution

Conceptualization: UB
Methodology: MAB, AAK, PK, IHS
Formal analysis: MAB
Writing review and editing: AAK, PK, MZ, IHS

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Cashman KD. Vitamin D Deficiency: Defining, Prevalence, Causes, and Strategies for Addressing. Calcified Tissue International. 2020 Jan; 106(1): 14–29. doi: 10.1007/s00223-019-00559-4.

[2] Amrein K, Scherkl M, Hoffmann M, Neuwersch-Sommeregger S, Köstenberger M, Tmava Berisha A, *et al.* Vitamin D Deficiency 2.0: An Update on the Current Status Worldwide. European Journal of Clinical Nutrition. 2020 Nov; 74(11): 1498–1513. doi: 10.1038/s41430-020-0558-y.

[3] Mendes MM, Charlton K, Thakur S, Ribeiro H, Lanham-New SA. Future Perspectives in Addressing the Global Issue of Vitamin D Deficiency. Proceedings of the Nutrition Society. 2020 May; 79(2): 246–251. doi: 10.1017/S0029665119001538.

[4] Mailhot G, White JH. Vitamin D and Immunity in Infants and Children. Nutrients. 2020 May; 12(5): 1233 . doi: 10.3390/nu12051233.

[5] Kapoor A, Baig F, Channa NA, Othman SS, Abualhamael SA, Baig M. Estimation of Calorie Intake, Iron, Zinc, and Selenium Among Children in Underprivileged Areas in Sindh, Pakistan. PLoS One. 2024 Jun; 19(6): e0304277. doi: 10.1371/journal.pone.0304277.

[6] Taylor SN. Vitamin D in Toddlers, Preschool Children, and Adolescents. Annals of Nutrition and Metabolism. 2020; 76(Suppl 2): 30–41. doi: 10.1159/000505635.

[7] Fiamenghi VI, Mello ED. Vitamin D Deficiency in Children and Adolescents with Obesity: A Meta-Analysis. Journal of Pediatrics (Rio de Janeiro). 2021 May–Jun; 97(3): 273–279. doi: 10.1016/j.jped.2020.08.006.

[8] Dominguez LJ, Farruggia M, Veronese N, Barbagallo M. Vitamin D Sources, Metabolism, and Deficiency: Available Compounds and Guidelines for Its Treatment. Metabolites. 2021 Apr; 11(4): 255. doi:

DOI: https://doi.org/10.54393/pjhs.v6i11.3187

10.3390/metabo11040255.

[9] Filgueiras MS, Rocha NP, Novaes JF, Bressan J. Vitamin D Status, Oxidative Stress, and Inflammation in Children and Adolescents: A Systematic Review. Critical Reviews in Food Science and Nutrition. 2020 Feb; 60(4): 660–669. doi: 10.1080/10408398.2018.1546671.

[10] Arshad S and Zaidi SJA. Vitamin D Levels Among Children, Adolescents, Adults, and Elders in the Pakistani Population: A Cross-Sectional Study. BMC Public Health. 2022; 22(1): 2040. doi: 10.1186/s12889-022-14526-6.

[11] Akhtar S. Vitamin D Status in South Asian Populations – Risks and Opportunities. Critical Reviews in Food Science and Nutrition. 2016; 56(11): 1925–1940. doi: 10.1080/10408398.2013.807419.

[12] Smith N, Sievert LL, Muttukrishna S, Begum K, Murphy L, Sharmeen T, *et al.* Mismatch: A Comparative Study of Vitamin D Status in British-Bangladeshi Migrants. Evolution, Medicine, and Public Health. 2021; 9(1): 164–173. doi: 10.1093/emph/eoab001.

[13] Tariq A, Khan SR, Basharat A. Assessment of Knowledge, Attitudes, and Practices Toward Vitamin D Among University Students in Pakistan. BMC Public Health. 2020 Mar; 20(1): 355. doi: 10.1186/s12889-020-8453-y.

[14] Maryam S, Saba S, Haider W, Afzal MS, Mukhtar S, Durrance-Bagale A, *et al.* Community-Based Social and Demographic Assessment of Knowledge, Attitudes, Practices, and Medical Conditions Related to Vitamin D Deficiency in Gilgit Baltistan, Pakistan. Journal of Biosocial Science. 2022 Nov; 54(6): 1100–1124. doi: 10.1017/S002193202100050X.

[15] Olczak-Kowalczyk D, Kaczmarek U, Gozdowski D, Turska-Szybka A. Association of Parental-Reported Vitamin D Supplementation with Dental Caries of 3-Year-Old Children in Poland: A Cross-Sectional Study. Clinical Oral Investigations. 2021 May; 25(5): 2887–2898. doi: 10.1007/s00784-021-03914-8.

[16] Libuda L, Timmesfeld N, Antel J, Hirtz R, Bauer J, Führer D, *et al.* Effect of Vitamin D Deficiency on Depressive Symptoms in Child and Adolescent Psychiatric Patients: Results of a Randomized Controlled Trial. European Journal of Nutrition. 2020 Dec; 59(8): 3415–3424. doi: 10.1007/s00394-020-02176-6.

[17] Camargo CA Jr, Sluyter J, Stewart AW, Khaw KT, Lawes CMM, Toop L, *et al.* Effect of Monthly High-Dose Vitamin D Supplementation on Acute Respiratory Infections in Older Adults: A Randomized Controlled Trial. Clinical Infectious Diseases. 2020 Jul; 71(2): 311–317. doi: 10.1093/cid/ciz801.

[18] Balla M, Merugu GP, Konala VM, Sangani V, Kondakindi H, Pokal M, *et al.* Back to Basics: Review on Vitamin D and Respiratory Viral Infections Including COVID-19. Journal of Community Hospital Internal Medicine Perspectives. 2020 Nov; 10(6): 529–536. doi: 10.1080/20009666.2020.1811074.

[19] Mahmood Y, Waris N, Fawwad A, Basit A. Vitamin D Deficiency and Diseases: A Review from Pakistan. Journal of Diabetology. 2021 Oct–Dec; 12(4): 391–400. doi: 10.4103/jod.jod_32_21.

[20] Grant WB, Lahore H, McDonnell SL, Baggerly CA, French CB, Aliano JL, *et al.* Evidence That Vitamin D Supplementation Could Reduce Risk of Influenza and COVID-19 Infections and Deaths. Nutrients. 2020 Apr; 12(4): 988. doi: 10.3390/nu12040988.