Vitamin D Status in Children: A Hospital-Based Retrospective Study

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ABSTRACT

Background:

Vitamin D deficiency is a common problem affecting both children and adults. It affects bone growth, deranges immune function and have long term effects on health. This study examines serum Vitamin D level of pediatric patients and to know the magnitude of Vitamin D deficiency, insufficiency and sufficiency in children.

Method:

This retrospective study conducted at Grande International Hospital includes 1,403 children aged 0–14 years between January 2021 to December 2024. Data of serum Vitamin D levels were extracted from the hospital medical record. Children were subdivided by age (0–5 years, 6–10 years and 11–14 years) and Vitamin D levels were classified into deficiency (<12 ng/mL), insufficiency (12-20 ng/mL), and sufficiency (>20 ng/mL) groups.

Result:

57.7% children were males and 42.3% children were females, with males having mean serum Vitamin D level of 27.79 ng/mL (SD 13.75) and female having 27.77 ng/mL (SD 16.41). Vitamin D deficiency was observed in 2.13%, insufficiency in 16.03%, and sufficiency in 81.84%. Deficiency and insufficiency are higher in older children, with deficiency rates of 1.05% (0-5 years), 2.49% (6-10 years), and 3.66% (11–14 years). Statistically significant sex differences were seen, with males at higher risk in ages 6–10 years and females at higher risk in ages 11–14 years.

Conclusion:

Majority of children have suboptimal Vitamin D level, with significant age and sex-related differences. Further study is needed for supplementation and screening programs.

Key words: Vitamin D**,** deficiency, insufficiency, sufficiency, children

Introduction

Vitamin D is a fat-soluble compound and is responsible for absorption of calcium and phosphate from intestine. It helps in bone formation, mineralization, and metabolic health in children and adolescents. Deficiency of Vitamin D results in impaired immune function, rickets in children and osteomalacia in adult. Vitamin D deficiency is a major public health problem in South Asia, affecting both urban and rural children despite abundant sunlight exposure[1,2]. High prevalence of Vitamin D deficiency was seen in different studies done in Nepal and India among infants, school-aged children, and adolescents[2,3]. Vitamin D deficiency can result from dietary insufficiency, reduced outdoor activity, inadequate sun exposure, dark skin color, and different cultural practices[2-4].

Recent studies from Nepal showed that around 60% of children and adolescents have Vitamin D levels below the recommended level[3]. Similarly,

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multi-center study from India showed low level of Vitamin D in over 50% of urban school children, with significant differences seen across different age groups and sex[4,5]. Vitamin D has a role in preventing disease of cardiovascular system, respiratory system, autoimmune, musculoskeletal and neurological disorder. Chronic Vitamin D deficiency in childhood can lead to complications such as decrease bone mass, rickets, weak immune system, metabolic and infectious diseases[1,5].

Due to high prevalence of Vitamin D deficiency and no clear guidelines on definition and dosing, the Indian Academy of Pediatrics (IAP) released revised guidelines in 2021, that define serum Vitamin D level cutoffs as: deficiency (<12 ng/mL), insufficiency (12–20 ng/mL), and sufficiency (>20 ng/mL)[6]. This guideline recommends to keep serum Vitamin D level above 20 ng/ml in children with high risk for Vitamin D deficiency. It also recommends different dose of Vitamin D supplementation in different age groups[6].

Study from Nepalese children aged 0–14 years showed, approximately 18% have Vitamin D level below sufficiency level, with both deficiency and insufficiency rates more in older age groups. Statistically significant sex differences are seen, with middle childhood boys and adolescent girls are at greater risk for Vitamin D deficency[5]. These results are similar to data published in Indian literature about Vitamin D deficiency. Hence, reinforcing revised newer IAP recommendations[6] in this region. Screening and universal supplementation are needed to prevent long term consequences of Vitamin D deficiency.

Material and Methods

This retrospective study was conducted at Grande International Hospital, Nepal. Lab data of serum Vitamin D level was collected from medical record from January 2021 to December 2024. Serum Vitamin D level of children aged 0 to 14 years were included for analysis. The study population include mix group of children attending hospital for regular checkup, healthy children, child with less weight and height as per growth chart, child with chronic lung, heart and kidney disease. Each childr Vitamin D level, age and sex were recorded for analysis.

The minimum required sample size was calculated using the formula, where Z represents confidence interval (1.96 for 95% confidence), p is an estimated prevalence of Vitamin D deficiency (0.3 or 30%) based on previous study by Kayastha P et al.[7] and e is the margin of error (5%). Based on these data, minimum sample of 323 children was calculated. To improve the strength of study, we included 1403 children.

Children were categorized in 3 groups, 0–5 years, 6–10 years, and 11–14 years. Sex as male or female. Serum Vitamin D level as deficiency (<12 ng/mL), insufficiency (12–20 ng/mL), and sufficiency (>20 ng/mL) according to the revised Indian Academy of Pediatrics (IAP) guidelines published in 2021[6].

Result was expressed in percentage and for each group, mean ± standard deviation (SD), median and standard error of mean (SEM) was calculated. p value <0.05 was considered as statistically significant. All data were entered in Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0 for Windows.

Result

A serum Vitamin D level of 1,403 children was analyzed, including 810 (57.7%) males and 593 (42.3%) females. The overall mean Vitamin D level was almost identical between males (27.79 ng/mL) and females (27.77 ng/mL). Standard deviation (SD) was similar for both (13.75 in males, 16.41 in females), and the median was 25.0 ng/mL, indicating symmetric distributions for both sexes. The standard error of mean was slightly less in males (0.48) due to the larger sample size, but they are comparable. The p value for the difference in means between sexes was 0.98, clearly indicating no statistically significant difference in mean Vitamin D levels between boys and girls. This supports that Vitamin D status does not vary by sex in our children as shown in Table 1.

Table 2 reflects sample sizes and their percentage of each sex within each Vitamin D level group. There are markedly more males in all categories. Means and medians of Vitamin D levels are closely aligned within each category, and SDs show larger

Table1: Mean value of Vitamin D in male and female:

Sex	N (%)	Mean ± SD (ng/mL)	SEM	Median
Male	810 (57.7%)	27.79 ± 13.75	0.48	25.00
Female	593 (42.3%)	27.77 ± 16.41	0.67	25.00

p value = 0.98

Table 2: Sex-wise distribution of all age group in accordance to their Vitamin D status

	VDD (<12 ng/mL) *		VDI (12-20 ng/mL) **		VDS (>20ng/ml) ***	
Sex	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
N (%)	49 (3.49%)	38 (2.71%)	208 (14.83%)	175 (12.47%)	553 (39.42%)	380 (27.08%)
Mean ± SD (ng/mL)	9.65 ± 1.36	9.45 ± 1.41	16.36 ± 2.52	16.25 ± 2.57	33.69 ± 12.70	34.91 ± 16.47
SEM	0.19	0.23	0.17	0.19	0.54	0.84
Median	10	10	16	16	30	30

*p value(sex) =0.50 **p value(sex) =0.68 ***p value(sex) =0.23

Table 3: Age and sex-wise distribution:

Characteristics Age group (yrs)	Male			Female			p value (vs other sex)
	N (%)	Mean ± SD (ng/mL)	Median (SEM)	N (%)	Mean ± SD (ng/mL)	Median (SEM)	
0-5 yrs	345 (60.31%)	30.43 ± 15.09	28 (0.81)	227 (39.69%)	32.02 ± 17.76	29 (1.18)	0.27
6-10 yrs	251 (59.90%)	25.75 ± 10.96	24 (0.69)	168 (40.10%)	27.93 ± 17.77	24 (1.37)	0.16
11-14 yrs	214 (51.94%)	25.93 ± 13.78	23 (0.94)	198 (48.06%)	22.76 ± 11.55	20 (0.82)	0.01

spread in the sufficient group (>20ng/ml). p values for mean differences between males and females within each Vitamin D level group are all above 0.05 (not statistically significant), indicating no sex effect on Vitamin D level in any group. Hence, the data indicate comparable Vitamin D level for males and females within each deficiency category. This supports reporting that sex is not a significant determinant of Vitamin D status in our study population.

Table 3 shows age and sex-wise distribution and each age group includes both male and female subjects, with a slightly higher proportion of males in younger age groups. Mean Vitamin D levels ranged from about 22.76 ng/mL (older females) to 32.02 ng/mL (younger females), with SD and median values reflecting a moderate spread and slight skew toward higher values in younger children. The standard error of the mean (SEM) indicates the precision of the mean; medians were similar to means, suggesting distributions are moderately symmetric within groups. No significant difference in mean Vitamin D levels between sexes for age group 0-5yr and 6-10 yrs (p = 0.27 and 0.16 respectively). A small but statistically significant difference for the older group (11-14 years), where males had higher mean levels than females (p = 0.01).

In table 4, each age/Vitamin D level group is split into male and female subgroups, with proportions shown. Younger ages generally have more males; older groups are closer to balanced. Means Vitamin D levels increase sharply with higher Vitamin D level in all age groups: <12ng/ml groups have means ~9–10ng/ml, 12–20ng/ml groups ~16ng/ml, and >20ng/ml groups above 32ng/ml. Standard deviations and SEMs are larger for sufficient groups (>20ng/ml), reflecting greater dispersion. Median values closely match means in all rows, showing symmetry. Statistically significant p values (p value for difference across age groups within each status) for deficient and insufficient categories (<12ng/ml and 12–20ng/ml), are not significant (all >0.2 and >0.3 respectively) indicating mean Vitamin D does not significantly vary by age. For sufficient category (>20ng/ml), p value is highly significant (0.00), showing mean Vitamin D differs by age among those with highest levels (youngest children have highest means, older children have lower level).

In Histogram & KDE (Overall Distribution of Vitamin D Levels among All Children) shape & Central Tendency shows the distribution is right-skewed, with most values concentrated between 10 and 40 ng/mL. The median is 25.0 ng/mL, and the mean is about 27.8 ng/mL, indicating that most children have Vitamin D levels above the classical deficiency

Table 4 Age-wise distribution as per Vitamin D status

	VDD (<12 ng/mL) *			VDI (12-20 ng/mL) **			VDS (>20 ng/ml) ***		
Characteristics Age group (yrs)	N (%)	Mean ± SD (ng/mL)	Median (SEM)	N (%)	Mean ± SD (ng/mL)	Median (SEM)	N (%)	Mean ± SD (ng/mL)	Median (SEM)
0-5 yrs	20 (1.43%)	9.30 ± 1.59	10 (0.36)	122 (8.7%)	16.57 ± 2.54	16 (0.23)	430 (30.65%)	36.18 ± 15.48	32 (0.75)
6-10 yrs	28 (2.0%)	9.93 ± 1.09	10 (0.21)	115 (8.2%)	16.10 ± 2.66	16 (0.25)	276 (19.67%)	32.70 ± 13.71	30 (0.83)
11-14 yrs	38 (2.78%)	9.44 ± 1.43	10 (0.23)	146 (10.41%)	16.26 ± 2.44	16 (0.20)	227 (16.18%)	32.22 ± 12.36	28 (0.82)

*p value (vs age) =0.22 **p value (Vs ages) = 0.34 ***p value (Vs ages) = 0.00

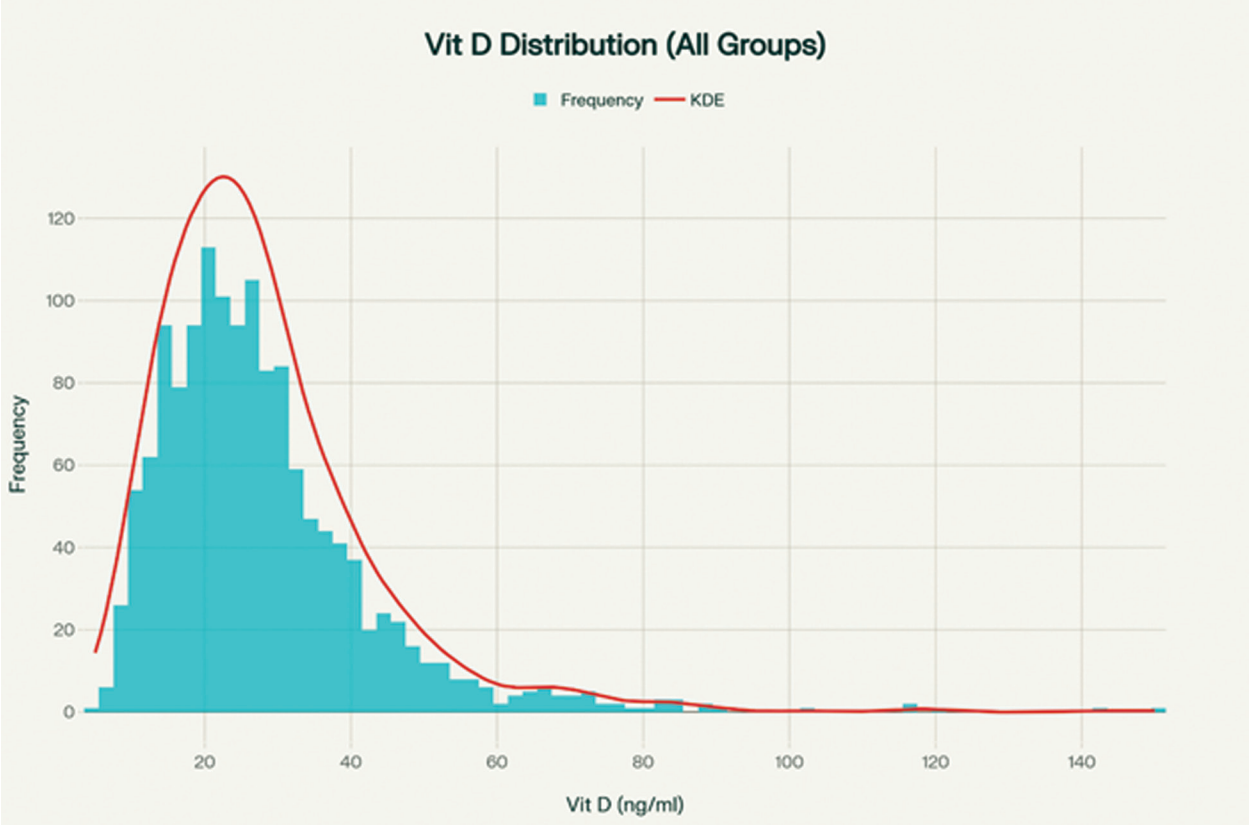

Figure 1: Histogram: Distribution of Vitamin D levels among all children (all groups combined)

cutoff but that a few higher values extend the mean. The range is wide (min = 5.0, max = 150.0), but the majority (75th percentile) is at or below 33.0 ng/mL. The SD is substantial (14.93), suggesting moderate heterogeneity—likely reflecting both deficient and sufficient subpopulations. There may be a minor peak between 15–25 ng/mL (insufficiency/sufficiency boundary). The long right tail represents a few children with much higher Vitamin D level. Hence, most of the pediatric population in our study falls in the sufficient or borderline-sufficient range for Vitamin D levels. Classic deficiency (far left, <12 ng/mL) is relatively uncommon.

Discussion

The current study provides a large-scale assessment of Vitamin D status in Nepalese children aged 0–14 years, using the updated 2021 Indian Academy of Pediatrics (IAP) guidelines to classify level of Vitamin D as sufficiency, insufficiency, and deficiency[6]. Compared to previous datasets from Nepal and India, our results show a relatively high

mean serum Vitamin D value (27.79 ng/mL in males and 27.77 ng/mL in females), and an overall lower prevalence of deficiency (2.13%) and insufficiency (16.03%) compared to many regional studies[4,5,7].

Indian studies frequently reveal low Vitamin D level exceeding 50% among school children and adolescents, with mean serum Vitamin D values ranging from 17 to 21 ng/mL in urban and semi-urban children[4,5]. A multicenter Indian study showed deficiency (<12 ng/mL) in up to 38% of children, with overall suboptimal levels in over 60%[5]. In Nepal, hospital-based and academic studies have documented deficiency rates as high as 60% in children and adolescents, especially during winter months and among those with limited sunlight exposure[3].

Our age stratified analysis aligns with well-established trends across South Asia, where younger children show higher sufficiency rates (87.57% in 0–5 years) while both deficiency and insufficiency increase with age (6–10 years: 80.91% sufficient; 11–14 years: 72.73% sufficient)[3]. Researchers from India and Nepal link this trend to factors like reduced outdoor activity, changing dietary habits, skin color, and cultural factors such as clothing in adolescent girls[3,4,5,8].

Sex-specific analysis in our cohort showed comparable mean Vitamin D levels between males and females overall, though adolescent girls exhibited higher insufficiency rates, consistent with Indian studies reporting higher deficiency risk in females (with lower odds ratios for girls in adolescence) indicating increased risk[5]. In contrast, boys in middle childhood were more likely to be deficient, potentially due to gender-based variations in physical activity or sunlight exposure, as evidenced by the odds ratios in our findings.

When subjects were categorized according to revised Indian Academy of Pediatrics (IAP) 2021 criteria, 2.13% were found to be Vitamin D deficient (<12 ng/mL), 16.03% were insufficient (12–20 ng/mL), and 81.84% had sufficient levels (>20 ng/mL)[6]. The prevalence of deficiency and insufficiency increased with age: deficiency rates were 1.05% in children 0–5 years, 2.49% in 6–10 years, and 3.66% in 11–14 years; corresponding insufficiency rates were 11.38%, 16.59%, and 23.61% respectively. Indian Academy of Pediatrics (IAP) 2021 guidelines provides greater clarity in classifying and comparing serum Vitamin D level. The new cutoffs (<12 ng/mL for deficiency, >20 ng/mL for sufficiency) show our children have a lower burden compared to many Indian datasets, but the trend of increasing deficiency and insufficiency in older children and girls is consistent[3,5,6,8]. IAP recommends universal supplementation (400 IU/day) for all children, with emphasis on regular screening and targeted interventions in at-risk groups[6]. Our data suggest implementing these guidelines would benefit Nepalese children, especially in older age groups and adolescent girls.

Major strengths of this study include the large sample size, comprehensive age and sex stratification. However, limitations include its retrospective study and lack of data on diet, physical activity, and sunlight exposure, which are known risk factors influencing Vitamin D status in South Asia[3,4]. There was no detail information about the patient underlying diseases or comorbid conditions was taken into consideration, hence, no association between underlying conditions and Vitamin D deficiency was known.

In conclusion, our study shows that Nepalese children have slightly better mean Vitamin D level and lower prevalence of deficiency compared to urban Indian children, but share a similar age and gender-related risk profile. The study highlights the need for continuous screening, supplementation, and educational campaigns in pediatric populations of Nepal[4,6].

References:

1. Holick MF. Vitamin D deficiency. N Engl J Med. 2007;357(3):266281. doi:10.1056/NEJMra070553
2. Mithal A, Wahl DA, Bonjour JP, Burckhardt P, DawsonHughes B, Eisman JA, et al. Global vitamin D status and determinants of hypovitaminosis D. Osteoporos Int. 2009;20(11):18071820. doi:10.1007/s00198-009-0954-6
3. Joshi HS, et al. Vitamin D deficiency in Nepal: prevalence and determinants. Clinic One Nepal. 2020.
4. Ritu G, Gupta A. Vitamin D deficiency in India: prevalence, causalities and interventions. Nutrients. 2014;6(2):729775. doi:10.3390/nu6020729
5. Khadilkar A, Kajale N, Oza C, et al. Vitamin D status and determinants in Indian children

and adolescents: a multicentre study. Sci Rep. 2022;12(1):16790. doi:10.1038/s41598-022-21279-0

6. Indian Academy of Pediatrics (IAP). Revised (2021) guidelines on prevention and treatment of vitamin D deficiency and rickets. Indian Pediatr. 2022;59(2):142148. PMID:34969941

7. Kayastha P, Chaudhary RK, Basnet S. Prevalence of Vitamin D Deficiency and its Awareness and Knowledge Among Parents. J Nepal Paediatr Soc. 2021;41(2):226-32. doi: 10.3126/jnps.v41i2.30657

8. Shukla K, Sharma S, Gupta A, Raizada A, Vinayak K. Current Scenario of Prevalence of Vitamin D Deficiency in Ostensibly Healthy Indian Population: A Hospital Based Retrospective Study. Indian J Clin Biochem. 2016;31(4):452-457. doi:10.1007/s12291-016-0552-2