Section: Pediatrics

Original Research Article

EVALUATION OF VITAMIN-D DEFICIENCY AND CALCIUM STATUS IN SCHOOL-AGED CHILDREN AND ADOLESCENTS: A TEACHING HOSPITAL BASED STUDY

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ABSTRACT

Background: In India as well as throughout the world, vitamin D insufficiency is becoming more widely acknowledged. According to reports from all around India, vitamin-D insufficiency ranges from 30 to 90% in all age categories, including newborns, teenagers, and expectant and nursing mothers. **Materials and Methods:** 76 kids between the ages of 7 and 19 were included in the non-probability convenient sampling. Children in good health who came in for regular checkups were included. **Result:** There were three categories for vitamin D status: insufficient (10–30 ng/ml), sufficient (>30 ng/ml), and deficient (<10 ng/ml). According to frequency analysis, 25.84% were sufficient, 13.68% were insufficient, and 18.24% were defective. As a result, more than half (55.3%) of the kids had vitamin D levels. A comprehensive and detailed overview of vitamin D status and its determinants in school-aged children and adolescents is provided by this thorough reporting of both continuous and categorical data. **Conclusion:** The IAP has proposed recommendations for the prevention and treatment of vitamin D and calcium deficit in light of the rising incidence of vitamin D deficiency and the uncertainty surrounding supplementation and treatment of vitamin D deficiency for different age groups. With 18.24% of participants classified as deficient and 13.68% as insufficient, this study shows that vitamin D deficiency is very common among school-aged children and adolescents. It also shows a strong positive correlation between serum vitamin D and calcium levels, highlighting their combined importance for bone health and development.

INTRODUCTION

Globally, including in India, vitamin D insufficiency is becoming more widely acknowledged.[1] Vitamin D deficiency has been found in 30–90% of cases across all age categories in India, including newborns, teenagers, pregnant women, and nursing mothers.[2] Additionally, numerous studies conducted throughout India have found that children and adolescents, particularly those from lower socioeconomic strata, have consistently inadequate calcium intakes.[3] It is crucial to address the problems of vitamin D and calcium deficiencies in the pediatric and adolescent population because both are essential for musculoskeletal health during the growing years. Rickets in infants and adolescents, or osteomalacia (abnormal mineralization of bone matrix) and muscle weakness in older children and adolescents, can be caused by vitamin D deficiency (with or without calcium deficit).[4] Additionally, poor bone mineral density in childhood can lead to osteoporosis in maturity due to vitamin D deficiency's detrimental effects on peak bone mass.[5] Neonatal rickets caused by a mother's lack of vitamin D can cause hypocalcemic seizures and, in rare cases, cardiomyopathy.[6] This Guideline does not address these effects of vitamin D because there is disagreement among scientists and physicians regarding the significance of vitamin D supplementation in relation to extraskeletal effects, especially in paediatrics.[7] A sufficient diet of calcium and vitamin D can prevent and treat rickets caused by calcium and/or vitamin D deficiencies.[8] However, there is no increased risk of fractures in children with vitamin D deficiency who do not exhibit indications of rickets or elevated parathormone (PTH).[9] A variety of health conditions, including as poor bone mineralization, a higher risk of autoimmune illnesses, and weakened immune systems, have been linked to vitamin D

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insufficiency, according to earlier research.[10] Together, these nutrients are necessary for children's normal growth and skeletal integrity. Calcium, another crucial nutrient for bone development, depends on vitamin D for optimum absorption in the stomach.[11] Our goal was to ascertain the prevalence of vitamin-D deficiency in children between the ages of 7 and 19 in order to evaluate its correlation with serum calcium levels and associated dietary and lifestyle factors.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted in the department of pediatrics, WCMSRH, Jhajjar. 76 kids between the ages of 7 and 19 were included in the non-probability convenient sampling. Children in good health who came in for regular checkups were included; skeletal problems, recent supplementing, and chronic sickness were excluded. Structured questionnaires were used to gather information on supplement use, dietary practices, and sun exposure. Standardized laboratory techniques were used to assess the amounts of calcium and vitamin D in serum (Gettin-1100 and EM-200 Erba). The institutional ethics committee granted ethical approval. SPSS-20.0 was used for statistical analysis, which included non-parametric tests and Pearson's correlation.

RESULTS

With 51% female and 49% male participants, the study's 76 respondents showed balanced socioeconomic and demographic representation. The distribution of age groups was as follows in fig.1: 9.12% were between the ages of 7 and 9, 10.64% were between the ages of 9 and 11, 12.16% were between the ages of 11 and 13, 11.4% were between the ages of 13 and 15, 8.36% were between the ages of 15 and 17, and 6.08% were between the ages of 17 and 19.

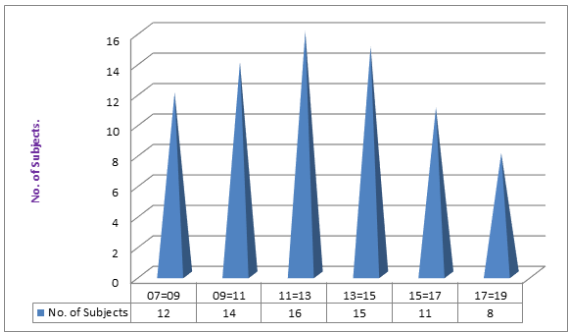

Figure 1: Shows the No. of Subjects in different age groups.

With 32% of children coming from low-income homes, 34% from middle-income families, and 34% from high-income origins, socioeconomic status was equally varied. The findings' generalizability across age, gender, and socioeconomic classes is supported by these distributions. According to dietary trends, 30% of kids ate dairy every day, 20% three to five times a week, 29% once or twice a week, and 21% infrequently or never. 18.42% of respondents said they consumed vitamin D-rich foods every day, 28.94% three to five times a week, 27.63% once or twice a week, and 25.0% infrequently or never. In terms of supplementation, 51.31% did not use vitamin D supplements, compared to 48.68% who did. According to patterns of sun exposure, 30.26% of people spent more than an hour outside each day, 26.31% spent between thirty and sixty minutes, 23.64% spent less than thirty minutes, and 19.73% had little to no exposure. The best time for vitamin D production, noon sun exposure, was only reported by 21.05% of respondents. According to clinical health data, 34.7% of children had a history of vitamin D insufficiency.

Fig.2- Shows descriptive statistics for continuous variables. Serum calcium levels were 7.98 ± 1.02 mg/dl and vitamin D levels were 26.24 ± 8.64 ng/ml on average.

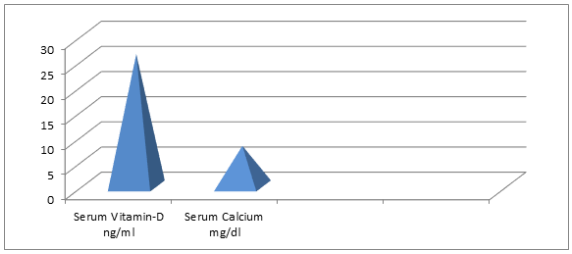

Figure 2: Mean Levels of Serum Vitamin-D & Serum Calcium

There were three categories for vitamin D status: insufficient (10–30 ng/ml), sufficient (>30 ng/ml), and deficient (<10 ng/ml). According to frequency analysis, 25.84% were sufficient, 13.68% were insufficient, and 18.24% were defective. As a result, more than half (55.3%) of the kids had vitamin D levels that were below ideal in [Table1 &Figure 3].

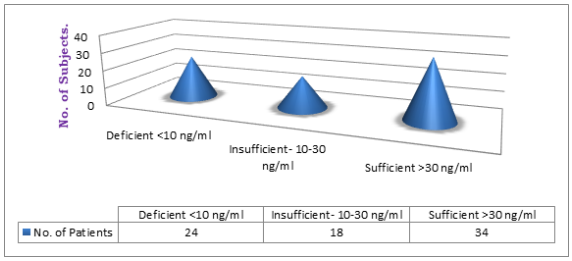

Figure 3: Shows the Shows the status of serum vitamin-D levels.

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Table 1: Shows the status of serum vitamin-D levels.

Parameters	No. of patients (%)
Deficient <10 ng/ml	24(18.24%)
Insufficient -10-30 ng/ml	18(13.68%)
Sufficient >30 ng/ml	34(25.84%)

Pearson's correlation was used to investigate relationships between vitamin D levels and modifiable factors. Serum vitamin D was strongly positively correlated with dairy consumption (ρ=0.15, p=0.015), vitamin D-rich food intake (ρ=0.36, p=0.001), supplement use (ρ=0.24, p=0.036), and sun exposure frequency (ρ=0.14, p=0.023). The strongest correlation was found with midday solar exposure (ρ=0.28, p=0.014). There were also significant health adverse correlations. Serum vitamin D was significantly inversely linked with identified bone diseases (ρ=–0.27, p=0.01), bone pain or muscle weakness (ρ=–0.12, p=0.031), and vitamin D deficiency (ρ=–0.32, p=0.004). Furthermore, a significant positive connection (ρ=0.27, p<0.01) was found between calcium levels and serum vitamin D. Even after controlling for age and BMI, regression analysis showed that every 1.1 ng/ml increase in vitamin D predicted a 0.056 mg/dl rise in calcium (p=0.02). Significant differences were found in non-parametric comparisons: greater dairy consumption was linked to higher vitamin D status, noon sun exposure was better than morning exposure, and supplement users had higher vitamin D levels than non-users. Complete-case analysis was used to address missing data, which made up less than 2% of records. SPSS-20.0 was used for all analyses. A comprehensive and detailed overview of vitamin D status and its determinants in school-aged children and adolescents is provided by this thorough reporting of both continuous and categorical data.

DISCUSSION

With over half of the sample showing suboptimal serum vitamin D levels, the current study offers strong evidence that vitamin D deficiency among school-aged children and adolescents continues to be a major public health concern. In particular, 18.24% of individuals were found to be vitamin D deficient, and another 13.68% to be insufficient. These results are in good agreement with earlier studies conducted in the South Asian region.[12] These findings highlight the multifactorial etiology of this nutritional deficiency, which includes limited sun exposure, inadequate dietary intake, socioeconomic constraints, and cultural practices that limit outdoor activity, especially among females.[13] They also reinforce the persistent nature of this nutritional deficiency despite the region's abundant sunlight. Consistencies and distinct regional difficulties are shown by comparison with national and international studies. According to many research, the general population in India has vitamin D deficiency rates as high as 71.0%, with children and adolescents being the most vulnerable. In Nepal, where urbanization, air pollution, and traditional dress further restrict effective sunshine exposure, similar prevalence rates have been reported. This study's result that a lower socioeconomic position is associated with a higher incidence of deficiency is consistent with research from the United Arab Emirates and other nations where access to vitamin D-rich foods and supplements is hampered by budgetary constraints.[14] However, traditional local diets seldom include fortified foods or fatty fish, which increases the risk of deficiency, in contrast to other Western populations where food fortification and supplements are more common. Mechanistically, the study's finding of a significant positive connection between calcium levels and blood vitamin D is in line with the known biological function of vitamin D in promoting intestinal calcium absorption and preserving bone mineralization.[15] This connection is crucial during times of fast growth, such childhood and adolescence, when there is a high need for calcium and insufficient vitamin D can lead to rickets, hypocalcemia, and other musculoskeletal conditions. The substantial negative relationships between vitamin D status and these health outcomes further demonstrate the therapeutic significance of vitamin D sufficiency for preventing bone pain, muscle weakness, and bone-related disorders. These findings are consistent with global recommendations highlighting the significance of vitamin D for the health of children's bones and the avoidance of osteomalacia and rickets.[16] The study includes a number of drawbacks despite its advantages, which include a representative sample, thorough evaluation of dietary and lifestyle factors, and strict laboratory procedures. The use of non-probability sampling may add selection bias, limiting generalizability outside of the study environment, and the cross-sectional design limits causal inference.[17] Recall bias may affect the use of self-reported dietary and sun exposure data. Furthermore, the sample size might not capture less prevalent determinants or outcomes, even while it is sufficient for identifying moderate relationships. Parathyroid hormone and other biochemical markers that could help clarify the pathophysiological pathways connecting calcium homeostasis and vitamin D were not evaluated in this study. In order to provide a more thorough understanding of mineral metabolism, future research should use longitudinal designs to elucidate temporal correlations and causality, increase sample numbers for increased statistical power, and include additional biomarkers. It is necessary to conduct intervention studies to assess the efficacy of supplementation, dietary

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fortification, and culturally appropriate educational initiatives. Furthermore, qualitative studies examining obstacles to sun exposure and dietary modification, especially for females and families with lower incomes, may help develop more successful public health initiatives. This study supports the high incidence of vitamin D insufficiency and its strong correlation with children's calcium status.[18]

CONCLUSION

The IAP has proposed recommendations for the prevention and treatment of vitamin D and calcium deficit in light of the rising incidence of vitamin D deficiency and the uncertainty surrounding supplementation and treatment of vitamin D deficiency for different age groups. With 18.24% of participants classified as deficient and 13.68% as insufficient, this study shows that vitamin D deficiency is very common among school-aged children and adolescents. It also shows a strong positive correlation between serum vitamin D and calcium levels, highlighting their combined importance for bone health and development. These results have important ramifications for clinical practice and public health, highlighting the necessity of proactive measures including dietary fortification, regular supplementation, and focused education to enhance sun exposure and dietary practices in this susceptible group. Comprehensive interventions are necessary to lessen the burden of deficiency-related musculoskeletal issues and promote optimal growth and well-being, given the complex etiology involving limited sun exposure, inadequate nutritional intake, and socioeconomic constraints. In order to assess the efficacy of these preventative approaches and guide policy decisions for long-term improvements in pediatric health, future research should concentrate on longitudinal and interventional studies.

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