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Association Between Vitamin D Levels and other Oral Health Issues in Children

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Abstract
Vitamin D is essential for maintaining oral health, particularly in children. Emerging evidence suggests a possible association between vitamin D deficiency and various oral health issues, including dental caries. This study aims to evaluate the serum vitamin D levels in children with dental caries compared to healthy controls. This case-control study was conducted over one year at Pacific Dental College, Debari. A total of 200 children were enrolled, with 100 children diagnosed with dental caries (cases) and 100 healthy children (controls). Serum vitamin D levels were measured using enzyme-linked immunosorbent assay (ELISA). Statistical analysis was performed to compare the vitamin D levels between the two groups. The mean serum vitamin D level in the dental caries group was found to be 18.5 ng/mL (±4.2), while in the control group, it was 28.3 ng/mL (±5.1). A significant difference ($p<0.01$) was observed between the two groups, indicating lower vitamin D levels in children with dental caries. Furthermore, a negative correlation ($r=-0.45$, $p<0.01$) was observed between vitamin D levels and the incidence of dental caries. The findings suggest a significant association between low serum vitamin D levels and the occurrence of dental caries in children. Ensuring adequate vitamin D levels could be a potential preventive measure for reducing the prevalence of dental caries. Further research is warranted to explore the underlying mechanisms and the benefits of vitamin D supplementation in pediatric dental care.

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Key Words
Vitamin D, dental caries, oral health, children, serum levels, case-control study

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INTRODUCTION

Vitamin D is a fat-soluble vitamin crucial for bone health, calcium homeostasis and immune function. Its role extends beyond these classical functions, impacting various aspects of overall health, including oral health. The primary source of vitamin D is sunlight exposure, with dietary intake contributing to a lesser extent. Despite its availability, vitamin D deficiency remains prevalent globally, affecting individuals across all age groups, including children[1].

Dental caries, a multifactorial disease, is one of the most common chronic conditions affecting children worldwide. It results from the interaction of pathogenic bacteria, dietary sugars, and host factors, leading to the demineralization of tooth enamel and dentine[2]. The relationship between vitamin D levels and dental caries has been an area of growing interest. Vitamin D is believed to influence oral health through several mechanisms, including the regulation of calcium and phosphate metabolism, which are vital for tooth mineralization and the modulation of immune responses that can affect the oral microbiome[3].

Several studies have explored the association between vitamin D deficiency and an increased risk of dental caries. For instance, Schroth[4] found that children with lower serum vitamin D levels had a higher prevalence of early childhood caries. Similarly, a study by Tanaka[5] reported a significant inverse relationship between serum vitamin D levels and the incidence of dental caries in school-aged children. These findings suggest that adequate vitamin D levels may play a protective role in maintaining oral health.
Despite the existing evidence, the relationship between vitamin D deficiency and dental caries remains under-researched in many populations. This study aims to evaluate the serum vitamin D levels in children with dental caries compared to healthy controls at the Pacific Dental College, Debari. By understanding this association, we can better inform preventive strategies and interventions to improve pediatric oral health outcomes.

MATERIALS AND METHODS

Study Design and Setting: This case-control study was conducted over a period of one year, from June 2023 to May 2024, at Pacific Dental College, Debari. The study was approved by the Institutional Ethics Committee and written informed consent was obtained from the parents or guardians of all participating children.

Study Population: A total of 200 children aged 6 to 12 years were enrolled in the study. The case group consisted of 100 children diagnosed with dental caries, while the control group included 100 healthy children without any signs of dental caries. The diagnosis of dental caries was made based on clinical examination and radiographic findings following the criteria established by the World Health Organization (WHO).

Inclusion and Exclusion Criteria:
Inclusion Criteria:

- Children aged 6-12 years.
- **For cases:** presence of at least one dental caries lesion.
- **For controls:** absence of dental caries and other significant oral health issues.

Exclusion Criteria:

- Children with systemic diseases affecting vitamin D metabolism.
- Those currently on vitamin D supplementation.
- Children with chronic illnesses or conditions requiring long-term medication.

Data Collection:

- **Clinical Examination:** All children underwent a comprehensive oral examination conducted by a trained pediatric dentist. The examination included visual inspection and bitewing radiographs to identify the presence of dental caries.
- **Serum Vitamin D Measurement:** Blood samples (5 mL) were collected from each participant by venipuncture. The samples were centrifuged and serum was separated and stored at-20°C until analysis. Serum vitamin D levels were measured using enzyme-linked immunosorbent assay (ELISA) kits (25-OH Vitamin D ELISA Kit, DRG Instruments GmbH, Germany), following the manufacturer's instructions. Vitamin D deficiency was defined as serum 25-hydroxyvitamin D levels <20 ng/mL.
- **Statistical Analysis:** Data were analyzed using SPSS software version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the baseline characteristics of the study participants. The mean and standard deviation (SD) of serum vitamin D levels were calculated for both groups. An independent t-test was used to compare the mean serum vitamin D levels between the case and control groups. Pearson's correlation coefficient was used to evaluate the relationship between serum vitamin D levels and the incidence of dental caries. A $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSIONS

Participant Characteristics: A total of 200 children were included in the study, with 100 children in the dental caries group (cases) and 100 children in the control group. The mean age of the participants was

Table 1: Serum Vitamin D Levels in Cases and Controls

Group	Mean Vitamin D Level (ng/mL)	Standard Deviation (SD)	Range (ng/mL)
Cases	18.5	4.2	10.1 - 26.9
Controls	28.3	5.1	20.2 - 38.7

Table 2: Comparison of Serum Vitamin D Levels between Cases and Controls

Group	Mean Difference (ng/mL)	t-value	p-value
Cases vs Controls	-9.8	-14.67	<0.01

Table 3: Correlation between Serum Vitamin D Levels and Dental Caries

Variable	Pearson Correlation Coefficient (r)	p-value
Vitamin D levels & Dental Caries	-0.45	<0.01

8.5 years (±2.1) for the cases and 8.7 years (±2.3) for the controls. There was no significant difference in the age and gender distribution between the two groups (p>0.05).

Serum Vitamin D Levels: The mean serum vitamin D level in the dental caries group was significantly lower compared to the control group (p<0.01). The details of serum vitamin D levels are presented in (Table 1).

Comparison of Vitamin D Levels: An independent t-test showed a statistically significant difference in serum vitamin D levels between the cases and controls, indicating lower levels in children with dental caries (t=-14.67, p<0.01).

Correlation Analysis: A negative correlation was observed between serum vitamin D levels and the incidence of dental caries (r=-0.45, p<0.01), suggesting that lower vitamin D levels are associated with a higher incidence of dental caries.

These results indicate a significant association between low serum vitamin D levels and the presence of dental caries in children. Ensuring adequate vitamin D levels could potentially play a role in the prevention of dental caries.

This study aimed to investigate the association between serum vitamin D levels and the incidence of dental caries in children. Our findings indicate a significant difference in serum vitamin D levels between children with dental caries and healthy controls. Children with dental caries exhibited significantly lower levels of vitamin D compared to their caries-free counterparts. This supports the hypothesis that vitamin D deficiency may be linked to an increased risk of dental caries in children.

Our results are consistent with previous studies that have reported similar associations. Schroth[1] found that children with lower serum vitamin D levels had a higher prevalence of early childhood caries. Additionally, Tanaka[2] demonstrated a significant inverse relationship between serum vitamin D levels and the incidence of dental caries in school-aged children. These studies, along with our findings, suggest that maintaining adequate vitamin D levels may be crucial for oral health in children.

The role of vitamin D in oral health can be attributed to several mechanisms. Vitamin D plays a vital role in calcium and phosphate metabolism, essential for the formation and maintenance of healthy tooth enamel and dentin[3-7]. Moreover, vitamin D has been shown to possess antimicrobial properties, potentially influencing the oral microbiome and reducing the colonization of cariogenic bacteria[8-11]. These mechanisms provide a plausible explanation for the observed association between low vitamin D levels and increased dental caries risk.

The negative correlation observed between serum vitamin D levels and dental caries further supports the protective role of vitamin D in oral health. This correlation suggests that lower vitamin D levels may contribute to a higher susceptibility to dental caries. Ensuring sufficient vitamin D intake through diet, supplements and adequate sunlight exposure could be an effective strategy to prevent dental caries in children.

However, it is essential to acknowledge the limitations of our study. The cross-sectional design does not allow us to establish a causal relationship between vitamin D levels and dental caries. Longitudinal studies are needed to confirm the causative role of vitamin D deficiency in the development of dental caries. Additionally, other factors such as dietary habits, oral hygiene practices, and socioeconomic status, which were not controlled for in this study, may also influence the risk of dental caries and should be considered in future research.

Our study's strengths include a well-defined population and the use of standardized methods for measuring serum vitamin D levels and diagnosing dental caries. Despite these strengths, further research is warranted to explore the underlying biological mechanisms and to assess the potential benefits of vitamin D supplementation in preventing dental caries.

CONCLUSION

In conclusion, our study demonstrates a significant association between low serum vitamin D levels and the occurrence of dental caries in children. Ensuring adequate vitamin D levels could be a potential preventive measure to reduce the prevalence of dental caries. These findings highlight the importance of

monitoring and maintaining optimal vitamin D status in pediatric populations to promote overall oral health.

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