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Original Research Article

Association between vitamin D levels and extensive dental caries in children, Karnataka, India

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ABSTRACT

Background: Dental caries is a global public health concern, particularly for young children. The objective of the study was to investigate the severity of dental caries in children with vitamin D deficiency and to compare the vitamin D levels among children with extensive dental caries and without caries.
Methods: A case control study was carried out among 38 children between 2 to 16 years of age with 19 children in case (with dental caries) and 19 in control (without dental caries) groups from February 2022 to September 2023. Caries status of the children was recorded using decayed, extracted, missing, and filled teeth (DMFT) index. Every child had blood sample taken for serum 25(OH) vitamin D levels. After gathering all the data, it was statistically analysed.
Results: The mean serum 25(OH) vitamin D level was 24.93 ng/ml (SD±7.05) among cases and 18.67 ng/mL (S. D±8.88) among the controls. When the mean levels of serum 25(OH) vitamin D were compared between case and control groups, there was a statistically significant difference (p value=0.021). Simple linear regression in case group showed inverse correlation between the level of vitamin D and dental caries, however it was not statistically significant (p value=0.58).
Conclusions: Our results showed that there was no significant association between Vitamin D levels and dental caries. This may be due to small sample size which is one of the limitations of our study. We need further studies with larger sample size to study this association.

Keywords: Case control study, Children, Dental caries, India, Vitamin D

INTRODUCTION

Dental caries is the localized breakdown of tooth tissues that is caused by acidic waste products that are produced when bacteria digest food. If left untreated, it can cause discomfort, infections, and challenges with eating, speaking, and learning in children.[1] The development of dental caries in children is influenced by a number of variables, including maternal education, socioeconomic position, poor oral hygiene, inappropriate feeding practices, and a deficiency in vital minerals like vitamin D.[2-4] Vitamin D plays a significant role in dental health, particularly in the prevention of dental caries. It is essential for the regulation of calcium and phosphorus absorption, as well as for maintaining the health of skeletal and dental tissues.[3] However some studies have demonstrated a negative correlation between vitamin D levels and dental caries risk, meaning that higher vitamin D levels are linked to a decreased prevalence of caries.[5] Vitamin D deficiency causes unclear lamina dura in primary and permanent teeth, incomplete calcification of dentin, delay of tooth eruption, and spontaneous periapical abscesses without causative factors, such as dental caries, abrasion, tooth fracture, and tooth trauma.[6]

There is paucity of data about the role of vitamin D in children having extensive dental caries from the Indian subcontinent. Hence this study was carried out with objectives to investigate the severity of dental caries in children with vitamin D deficiency and to compare the vitamin D levels among children with extensive dental caries and without caries.

METHODS

The Department of Paediatrics, Kasturba medical college and hospital, Manipal collaborated with the department of Paedodontics, Manipal college of dental sciences (MCODS), Manipal to perform this case-control study between February 2022 to September 2023. The study comprised of two groups each consisting of 19 children. These groups were categorized as the case group and the control group, and their distribution, where 19 children in the case group were picked up from the outpatient department of Paedodontics, MCODS, Manipal. These children were aged between 2 and 16 years and diagnosed with extensive dental caries requiring oral rehabilitation. On the other hand, the control group comprised of 19 children aged between 2 and 16 years who presented for dental problems other than caries at the outpatient department of Paedodontics, MCODS, Manipal. Children <2 years or >16 years, children with chronic systemic illness such as rickets, renal disease, liver disease, malabsorption syndrome, chronic malnutrition or previously diagnosed to have vitamin D deficiency were excluded from the study. The study protocol received approval from the institutional ethics committee (IEC: 6/2022) prior to initiation of the study. Written informed consent was obtained from care givers of each child prior to the recruitment into the study. They were assured that the personal information of their child would be kept anonymous and confidential.

A detailed history of presenting illness including dental history was recorded using a pre-designed semi-structured questionnaire containing questions about pain in tooth, discoloration in tooth, bleeding gums, malocclusion of tooth, presence of mouth odour, loose tooth requiring extraction, brushing twice per day, type of diet (vegetarian/ non-vegetarian/ mixed), adequate consumption of milk (≥400 ml per day), usage of fluoride containing tooth paste and adequate exposure to sunlight in a day (>30 min/week of afternoon sun exposure to at least 40% body surface area). [7,8] This was followed by the detailed oral examination of each child by the investigator from Paedodontics Department. Caries status of the children was recorded using decayed, extracted, missing and filled teeth (DMFT) index.[9] A detailed systemic examination was conducted by the investigator from Paediatrics Department. History and physical examination findings were recorded in control population like the cases. A venous blood sample of approximately 2.5 ml was obtained from the study participants (cases and controls) and sent to the biochemistry laboratory for estimation of serum vitamin D levels. Serum vitamin D levels ≤20 ng/ml was considered as deficient, 21-29 ng/ml was considered as insufficient and ≥30 ng/ml was considered normal.[10] All the data was compiled and subjected to statistical analysis using mean, paired t-test, and simple linear regression, and compilation of the result was done. The serum vitamin D levels was compared between cases and controls for statistical significance.

RESULTS

A total of 38 children were enlisted, and they were split into two groups: 19 children with dental caries (the case group) and 19 children without any dental caries (the control group). The demographic characteristics of the study population is depicted in Table 1.

Table 1: Demographic characteristics of cases and controls.

Variable	Cases N (%)	Controls N (%)
Gender		
Male	12 (63.16)	11 (57.89)
Female	7 (36.84)	8 (42.11)
Age (years) Mean±SD	6.10±1.77	9.57±4.29
DMFT score Mean±SD	7.79±3.21	0

The clinical profile of study population is depicted in Table 2.

Table 2: Clinical profile of cases and controls.

Clinical data	Case N (%)	Control N (%)
Pain in the tooth	11(57.89)	1 (5.26)
Discoloration of teeth	15 (78.95)	2 (10.53)
Bleeding from gums	2 (10.53)	0 (0)
Malocclusion of teeth	3 (15.79)	7 (36.84)
Presence of mouth odour	4 (21.05)	3 (15.79)
Loose tooth requiring extraction	16 (84.21)	7 (36.84)
Brushing twice a day	5 (26.32)	2 (10.53)
Adequate milk intake	14 (73.68)	11 (57.89)
Type of diet		
Veg	5 (26.32)	9 (47.37)
Mixed (Veg and non-veg)	14 (73.68)	10 (52.63)
Adequate sunlight exposure	13 (68.42)	12 (63.16)
Fluoride containing tooth paste use	16(84.21)	13 (68.42)

The vitamin D levels among cases and controls are depicted in Table 3.

Table 3: Vitamin D levels among cases and controls (n=38).

Vit D levels (ng/mL)	Cases N (%)	Controls N (%)
Deficient (<=20)	5 (26.32)	12 (63.16)
Insufficient (21-29)	10 (52.63)	6 (31.58)
Normal (>=30)	4 (21.05)	1 (5.26)

A statistically significant difference was seen in the mean serum 25(OH) vitamin D levels between the case and control groups, with a p-value of <0.021 and a t-value of 2.405 as depicted in Table 4.

Table 4: Comparison of mean vitamin D levels between case and control groups.

Group	Vitamin D levels (ng/ml) Mean±SD	P value
Case	24.93±7.05	0.021
Control	18.67±8.88	

We used simple linear regression to examine the relationship between vitamin D levels and DMFT index. The results have shown inverse correlation between the level of Vitamin D and dental caries; however, it does not represent a statistically significant relationship (p=0.58) (Figure 1).

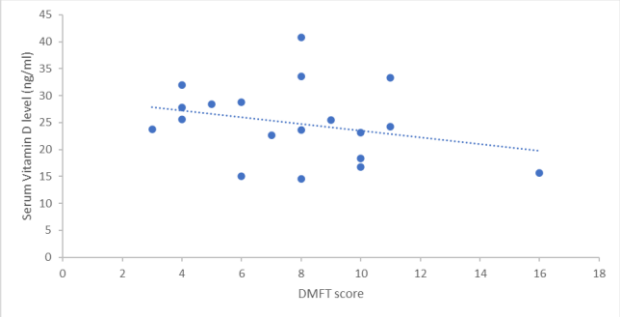

Figure 1: Correlation between levels of Vitamin D and DMFT score among the cases.

DISCUSSION

Vitamin D is essential for maintaining dental health through several different processes. The first researchers to discover a connection between vitamin D and dental caries were Mellanby and Pattison.[11] Both calcium and phosphorus aid in the mineralization of teeth, and vitamin D facilitates their absorption from the intestine.[12] Enamel hypoplasia has been linked to vitamin D deficiency in utero due to the metabolic damage to ameloblasts. Defective amelogenesis causes enamel hypoplasia, which can be clinically identified by pitting, grooves, or absence of enamel.[13] These defects increase the risk of early colonization of teeth by cariogenic bacteria, thereby resulting in dental caries.[14] The development of caries is typically a gradual process that takes years to manifest as a cavity.[15] As a result, the amount of serum 25(OH) D at the time of caries scoring may or may not correspond to the time frame during which the caries symptoms appeared. Vitamin D deficiency is a major epidemic globally including sun-rich Asian countries.[16]

In our case control study, we did not find an association between vitamin D deficiency and occurrence of dental caries as our sample size was limited. However, several studies have reported significant association between Vitamin D deficiency and occurrence of dental caries in children.[1,5,13,15,17-19] Many high-income nations have reported an overall drop in childhood dental caries during the past few decades. The reduction in dental caries among children in these nations can be attributed to various causes, including improved living conditions, fluoridation, improved oral health habits, and the implementation of preventive school health initiatives. On the other hand, low oral health care, a lack of oral health services, dietary deficiencies, low dental care, and restricted fluoridation are some of the main causes of the high caries prevalence in children in low-income countries.[20]

In comparison to children around the world, preschool-aged Southeast Asian children have a worse overall caries status as per the study by Duangthip D et al.[21] The DMFT score in preschool children in Southeast Asia ranged from 0.9-9.0 which is comparable with our study. A study by Ali N et al reported children with inadequate vitamin D (<20 ng/ml) having high caries score (DMFT≥4), while those with adequate vitamin D (>44 ng/ml) having a low caries score (DMFT<1).[22] Several other studies have reported highest DMFT scores in children with "Deficient level" of vitamin D, while the lowest values were found in those with "Sufficient level".[23-26] Studies have reported optimal vitamin D concentrations (≥75 nmol/L) to be associated with 39% lower odds for dental caries and overall caries experienced in young school-aged children.[15,27] Increased vitamin D levels have the ability to lower dental caries risk by promoting the production of antibacterial substances such as defensins and cathelicidin.[27,28] A meta-analysis by Hujoel PP et al on 14 controlled clinical trials assessing vitamin D3 as a supplement, compared to no supplement as a control reported a 49% (95% CI: 35, 60, P<0.0001) decrease in the relative rate of dental caries.[29]

A Swedish cohort study involving 6-year-old children who received vitamin D intervention reported an inverse association between vitamin D status and caries.[5] However, the proportion of children with insufficiency (<50 nmol/l) was higher in children with caries, despite univariate analysis showing that vitamin D levels did not change substantially between children with and without caries.[5] In a large Mendelian randomization study by Dudding T et al multivariable confounder adjusted analyses showed no strong evidence for an association between 25-hydroxy vitamin D and dental caries experience or severity.[1] However, there was evidence for

an association with early onset of caries in children, or having a general anaesthesia used for dental problems.[1] In fact, children's permanent dentition is also affected by the association between caries and vitamin D levels. Low vitamin D concentrations were substantially linked to advanced decay in permanent teeth, according to a study conducted in Portugal on children aged 7 years.[30] However, some studies found no significant association between vitamin D levels and dental caries in children.[31] In a study by Doğusal et al serum 25(OH)D concentrations did not appear to significantly affect dental caries or molar incisor hypo mineralization in children.[31] Furthermore, Herzog et al discovered no significant association between serum 25(OH)D levels and the occurrence of dental caries when blood 25(OH)D was below 30 nmol/l.[19] Silva et al study on Australian twins looking at prenatal and developmental risk factors did not find vitamin D to be a predictor of dental caries.[32]

Limitations of the study was a single-centre study with small sample size. Therefore, there is a need for large multi-centre studies to analyze the association between dental caries and vitamin D levels.

CONCLUSION

Our study did not find a significant association between vitamin D levels and extensive dental caries in children. Larger-scale studies with diverse populations and longitudinal designs would provide valuable insights into the role of vitamin D in dental health

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REFERENCES

1. Dudding T, Thomas SJ, Duncan K, Lawlor DA, Timpson NJ. Re-Examining the Association between Vitamin D and Childhood Caries. PLoS One. 2015;10(12):143769.
2. Prakash P, Subramaniam P, Durgesh BH, Konde S. Prevalence of early childhood caries and associated risk factors in preschool children of urban Bangalore, India: A cross-sectional study. Eur J Dent. 2012;6(2):141-52.
3. Al-Jubori SH, Al-Murad MA, Al-Mashhadane FA. Effect of Oral Vitamin D3 on Dental Caries: An In-Vivo and In-Vitro Study. Cureus. 2022;14(5):25360.
4. Stephen A, Krishnan R, Ramesh M, Kumar VS. Prevalence of early childhood caries and its risk factors in 18-72-month-old children in Salem, Tamil Nadu. J Int Soc Prev Community Dent. 2015;5(2):95-102.
5. Gyll J, Ridell K, Öhlund I, Karlsland Åkeson P, Johansson I, Lif Holgerson P. Vitamin D status and dental caries in healthy Swedish children. Nutr J. 2018;17(1):11.
6. Goodman JR, Gelbier MJ, Bennett JH, Winter GB. Dental problems associated with hypophosphataemic vitamin D resistant rickets. Int J Paediatr Dent. 1998;8(1):19-28.
7. DeBoer MD, Agard HE, Scharf RJ. Milk intake, height and body mass index in preschool children. Arch Dis Child. 2015;100(5):460-5.
8. Jindal AK, Gupta A, Vinay K, Bishnoi A. Sun Exposure in Children: Balancing the Benefits and Harms. Indian Dermatol Online J. 2020;11(1):94-8.
9. Moradi G, Mohamadi Bolbanabad A, Moinafshar A, Adabi H, Sharafi M, Zareie B. Evaluation of Oral Health Status Based on the Decayed, Missing and Filled Teeth (DMFT) Index. Iran J Public Health. 2019 ;48(11):2050-7.
10. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, Murad MH, Weaver CM; Endocrine Society. Evaluation, treatment, and prevention of vitamin D deficiency: An Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011;96(7):1911-30.
11. Mellanby M, Pattison CL. The action of vitamin D in preventing the spread and promoting the arrest of caries in children. Br Med J. 1928;2(3545):1079-82.
12. DeLuca HF. Overview of general physiologic features and functions of vitamin D. Am J Clin Nutr. 2004;80(6):1689S-96S.
13. Schroth RJ, Lavelle C, Tate R, Bruce S, Billings RJ, Moffatt ME. Prenatal vitamin D and dental caries in infants. Pediatrics. 2014;133(5):1277-84.
14. Caufield PW, Li Y, Bromage TG. Hypoplasia-associated severe early childhood caries--a proposed definition. J Dent Res. 2012;91(6):544-50.
15. Schroth RJ, Rabbani R, Loewen G, Moffatt ME. Vitamin D and Dental Caries in Children. J Dent Res. 2016;95(2):173-9.
16. L, Titan SM, Magalhães MC, Sassaki AL, dos Reis LM, Jorgetti V, Moysés RM. Vitamin D status in a sunny country: where has the sun gone? Clin Nutr. 2010;29(6):784-8.
17. Sellers EA, Friel J, Kliewer E, Moffatt ME. Vitamin D status of children with severe early childhood caries: a case-control study. BMC Pediatr. 2013;13:174.
18. Al-Darwish, Mohammed & Bener, Abdulbari & Hoffmann, Georg. Vitamin D deficiency and risk of dental caries among young children. A public Health Problem. Indian Journal of Oral Siences. 2013;4:75-82.
19. Herzog K, Scott JM, Hujoel P, Seminario AL. Association of vitamin D and dental caries in children: Findings from the National Health and Nutrition Examination Survey, 2005-2006. J Am Dent Assoc. 2016;147(6):413-20.
20. Jürgensen N, Petersen PE. Promoting oral health of children through schools--results from a WHO global survey 2012. Community Dent Health. 2013;30(4):204-18.

21. Duangthip D, Gao SS, Lo EC, Chu CH. Early childhood caries among 5- to 6-year-old children in Southeast Asia. Int Dent J. 2017;67(2):98-106.
22. Ali, Nusrat & Ali, Sarah. (2017). Vitamin D and Early Childhood Caries Pak Armed Forces Med. 2017;67(3):429-33.
23. El Shiekh, M.A., Hanafy, R.M.H. Relationship between vitamin D status and caries experience in a group of Egyptian children: a cross-sectional study. BMC Oral Health. 2023;374:24.
24. Williams TL, Boyle J, Mittermuller BA, Carrico C, Schroth RJ. Association between Vitamin D and Dental Caries in a Sample of Canadian and American Preschool-Aged Children. Nutrients. 2021;13(12):4465.
25. Chen Z, Lv X, Hu W, Qian X, Wu T, Zhu Y. Vitamin D Status and Its Influence on the Health of Preschool Children in Hangzhou. Front Public Health. 2021;9:675403.
26. Schroth RJ, Christensen J, Morris M, Gregory P, Mittermuller BA, Rockman-Greenberg C. The Influence of Prenatal Vitamin D Supplementation on Dental Caries in Infants. J Can Dent Assoc. 2020;86:13
27. Grant WB. A review of the role of solar ultraviolet-B irradiance and vitamin D in reducing risk of dental caries. Dermatoendocrinol. 2011;3(3):193-8.
28. Hewison M. Vitamin D and the immune system: new perspectives on an old theme. Endocrinol Metab Clin North Am. 2010;39(2):365-79.
29. Hujoel PP. Vitamin D and dental caries in controlled clinical trials: systematic review and meta-analysis. Nutr Rev. 2013;71(2):88-97.
30. Carvalho Silva C, Gavinha S, Manso MC, Rodrigues R, Martins S, Guimarães JT, Santos AC, Melo P. Serum Levels of Vitamin D and Dental Caries in 7-Year-Old Children in Porto Metropolitan Area. Nutrients. 2021;13(1):166.
31. Doğusal G, Sönmez I, Ünüvar T. Evaluation of Serum 25(OH)D Levels in Obese and Normal-Weight Children with Carious and Hypomineralized Teeth. J Clin Pediatr Dent. 2021;45(1):35-40.
32. Silva MJ, Kilpatrick NM, Craig JM, Manton DJ, Leong P, Burgner DP, Scurrah KJ. Genetic and Early-Life Environmental Influences on Dental Caries Risk: A Twin Study. Pediatrics. 2019;143(5):20183499.

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