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Original

The relationship between vitamin D and calcium serum levels with dental caries in 6-12 years old children

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Abstract

Introduction: There are limited studies with contradictory results on the relationship between vitamin D and calcium levels with dental caries at different ages.

Objectives: Given the contradictory results of studies and the importance of preventing the onset and progression of dental caries for oral health, this study aimed to find the relationship between vitamin D and calcium levels with dental caries in 6-12 years old children.

Patients and Methods: This descriptive-cross sectional study was conducted from 2019 to 2020 on 256 children of 6-12 years old referring to children's hospital in Tabriz. Serum vitamin D (sufficient, insufficient or deficient) and calcium (sufficient, insufficient) levels were measured for each child, and the relationship between their levels and dental caries was investigated by descriptive and inferential statistical tests.

Results: The dental index of decayed, missing and filled teeth (DMFT) in the deficient and insufficient vitamin D groups was significantly higher than in the sufficient vitamin D group ($P=0.03$). The linear regression model on the effect of age, vitamin D, and calcium on dental indexes showed no significant statistical relationship. However, in the case of the dental index, age, and calcium level affected dental caries (d), but vitamin D did not affect this index.

Conclusion: There was no significant relationship between calcium and vitamin D serum levels with dental caries in 6-12 years old children.

Keywords: Vitamin D, Calcium, Dental caries, Child

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Introduction

Dental caries is the most common chronic childhood disease, causing chewing problems, pain, and reduced life quality. Multiple physical, biological, environmental, and behavioral factors affect dental caries (1,2). Vitamin D is one of the effective biological factors, maintaining the proper concentration of calcium and phosphorous ions in the blood and causing normal mineralization of bones and teeth (3).

By adjusting the calcium level, vitamin D plays a key role in the formation of enamel, dentin, and bone, as ameloblasts and odontoblasts are the target cells for the most active form of vitamin D. Vitamin D deficiency during periods of dental development can cause developmental defects such as enamel hypoplasia, known as a risk factor for dental caries (4).

Despite prescribing vitamin D supplements to infants, vitamin D deficiency is common among Iranian children (5). Vitamin D deficiency is a major cause of neonatal rickets in most countries. The levels of vitamin D and its metabolites in breast milk are low, and weather conditions and clothes prevent from being exposed to sufficient ultraviolet radiation (6, 7).

Calcium metabolism changes when there is vitamin D deficiency, and the body cannot properly absorb calcium (8). By decreasing the calcium level, the parathyroid hormone (PTH) is stimulated, causing calcium excretion from skeleton resources. Moreover, PTH converts 25-hydroxy vitamin D to 1,25-Dihydroxyvitamin D3, increasing calcium absorption from the intestines. Therefore, vitamin D plays a crucial in maintaining oral health and mineral accumulation in bones and teeth, affecting dental susceptibility to caries (9).

Objectives

There are limited studies with contradictory results on the relationship between vitamin D and calcium levels with dental caries at different ages. Given the contradictory results of studies and the importance of preventing the onset and progression of dental caries for oral health, this study aimed to find the relationship between vitamin D and calcium levels with dental caries in 6-12 years old children.

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Implication for health policy/practice/research/ medical education

There are limited studies with contradictory results on the relationship between vitamin D and calcium levels with dental caries at different ages.In this descriptive-cross sectional study Serum vitamin D and calcium levels were measured for 6-12 years old child, and the relationship between their levels and dental caries was investigated by descriptive and inferential statistical tests. Results show no significant relationship between calcium and vitamin D serum levels with dental caries in 6-12 years old children.

Patients and Methods

Study design

This descriptive-analytical study was carried out by cross-sectional method in Tabriz children's hospital on 265 healthy (ASA Class I) 6-12 years old from the beginning of 2019 to the end of 2020. Children with metabolic diseases or complex medical diseases and those with gastrointestinal diseases, chronic renal failure, and respiratory diseases that affect the vitamin D level were excluded from the study. After a thorough examination for a checkup, the Physician prescribed vitamin D and calcium tests. All tests were conducted at the same laboratory (children's hospital) to achieve uniform results. The aim of the study was explained to the parents, then written informed consent was obtained. Vitamin D level higher than or equal to 30 ng/mL and less than 100 was considered sufficient. Vitamin D higher than or equal to 10 ng/mL and less than 30 ng/mL was considered insufficient, and vitamin D level less than 10 ng/mL was considered deficient. Calcium higher than or equal to 8.7 mg/dL was considered sufficient, and less than 8.7 mg/dL was considered deficient. Children were then examined by a pediatric resident dentist to record index of decayed, missing and filled teeth (DMFT).

Statistical analysis

The results of all tests were statistically analyzed by SPSS 23 at the significance level of 0.05. Data normality was examined by the Kolmogorov-Smirnov test. Given the non-normal data distribution, the nonparametric Mann-Whitney U test was used to examine the relationship between the vitamin D and calcium levels with dental caries indexes. The chi-square test was used to study the relationship between gender and calcium and vitamin D deficiency.

Results

Of 265 samples, 83 (31.3%) were male, and 182 children (68.7%) were female. As shown in Table 1, the mean DMFT+dmft decreases by increasing age, since the overall mean of DMFT+dmft was 4.38.

The nonparametric Mann-Whitney U test was

Table 1. Mean and sum of dmft and DMFT for different age groups

Age group	Statistical index	dmft	DMFT	DMFT+dmft
6-8 years old	Mean	5.25	0.36	5.61
	Number	85	85	85
	Standard deviation	3.45	0.89	3.44
8-10 years old	Mean	3.33	0.82	4.15
	Number	94	94	94
	Standard deviation	2.65	1.33	3.10
10-12 years old	Mean	1.33	2.08	3.40
	Number	86	86	86
	Standard deviation	1.89	1.96	2.50
Total	Mean	3.30	1.08	4.38
	Number	265	265	265
	Standard deviation	3.15	1.62	3.16

Table 2. Dental caries indexes in terms of calcium level

Caries index	Calcium level	Mean	Standard deviation	*P* value
d	Deficient	2.43	4.158	0.423
	Sufficient	2.33	2.872	
dmft	Deficient	3	4.041	0.553
	Sufficient	3.31	3.123	
D	Deficient	2.14	2.34	0.067
	Sufficient	0.75	1.21	
DMFT	Deficient	2.14	2.34	0.171
	Sufficient	1.05	1.59	

Vitamin D level: ng/mL; Calcium level: mg/dL

conducted to examine the relationship between the calcium level and dental caries indexes, given the non-normal distribution of dental indexes. As shown in Table 2, 2.6% of children suffer from calcium deficiency. There is no significant difference between children with calcium deficiency and those with sufficient calcium in terms of dental indexes. However, children with calcium deficiency had a higher dental index D than those with sufficient calcium, but the difference was not statistically significant.

Table 3 shows the relationship between the vitamin D level and dental caries indexes for children in different age groups. Considering the non-normal data distribution, the nonparametric Mann-Whitney U test was used to compare the two groups in terms of dental caries indexes. As shown, 70.5% of 6-18 years old children, 61.9% of 8-10 years old, and 74.4% of 10-12 years old children suffered from vitamin D deficiency.

In most cases, the dental caries indexes in the groups with sufficient vitamin D were lower than those with deficient or insufficient vitamin D; however, the difference was not statistically significant. In the 6-8 years old children, the dental index D was significantly higher in the groups with deficient and insufficient vitamin D than in those with sufficient vitamin D (P=0.09). The dental index DMFT in the group with insufficient vitamin D was significantly higher than the group with sufficient vitamin D (P=0.03). The linear regression model was conducted for a more exact comparison of groups and to investigate the effect of age, vitamin D, and calcium levels on dental indexes. No significant statistical relationship was found in these models. However, in the case of the dental index dmft, age and calcium level affected dental caries, but the vitamin D level did not impact this index.

By controlling age and calcium level, no significant relationship was found between the vitamin D level and dental indexes D and DMFT (Table 4).

Discussion

This study investigated the relationship between vitamin D and calcium levels with dental caries in 265 children of 6-12 years old. According to the results, 2.6% of children suffered from calcium deficiency, and 68.67% suffered from deficient or insufficient vitamin D. This is higher than vitamin D deficiency in other countries, so that 48.8%

Table 3. Mean and standard deviation of dental caries indexes in terms of age group and vitamin D level

Age group	Vitamin D level	DMFT	D	dmft	d
6-8 years old	Deficient+insufficient	0.47±1.01	0.37±0.88	5.33±2.95	3.9±2.89
	Sufficient	0.12±0.44	0.04±0.20	5.04±4.48	4.36±4.57
Mann-Whitney U test result		0.031	0.009	0.756	0.645
8-10 years old	Deficient+insufficient	0.98±1.51	0.79±1.25	3.46±2.73	2.53±2.67
	Sufficient	0.60±0.97	0.54±0.95	3.17±2.59	1.89±2.32
Mann-Whitney test result		0.145	0.288	0.618	0.229
10-12 years old	Deficient+insufficient	1.86±1.83	1.41±1.56	1.28±1.93	0.70±1.33
	Sufficient	2.73±2.22	1.41±1.46	1.45±1.81	0.86±1.55
Mann-Whitney test result		0.110	0.994	0.706	0.668
Total	Deficient+insufficient	1.09±1.59	0.8±1.31	3.2±3.04	2.3±2.69
	Sufficient	1.04±1.7	0.6±1.15	2.4±3.38	2.4±3.32
Mann-Whitney test result		0.581	0.285	0.782	0.757

Vitamin D level: ng/mL; Calcium level: mg/dL

Table 4. The results of the linear regression model on the effect of age, calcium, and vitamin D levels on DMFT, D, dmft, and d

Dependent variable (dental caries index)	Independent variable	B coefficient	Standard deviation	Beta coefficient	t test statistics	Test result
d	Vitamin D	0.007	0.007	0.056	1.03	0.30
	Calcium	0.06	0.029	0.113	2.10	0.03
	Age	-0.75	0.08	-0.473	-8.79	<0.001
dmft	Vitamin D	0.01	0.008	0.071	1.35	0.176
	Calcium	0.06	0.031	0.104	1.99	0.047
	Age	-0.886	0.091	-0.512	-9.76	<0.001
D	Vitamin D	0.00	0.003	0.008	0.14	0.88
	Calcium	-0.01	0.014	-0.043	-0.74	0.45
	Age	0.24	0.040	0.347	5.98	<0.001
DMFT	Vitamin D	0.003	0.004	0.44	0.77	0.43
	Calcium	-0.009	0.01	-0.03	-0.54	0.58
	Age	0.36	0.05	0.40	7.17	<0.001

Vitamin D level: ng/mL; Calcium level: mg/dL, Age: year.

of 7-16 Qatari people, 18.75% of 5-12 years old American children, and 49.9% of 6-11 years old Canadian children suffered from vitamin D deficiency. This difference can be related to the difference in the age of samples, eating habits, oral health, and methods used for caries prevention (10-12).

The overall experience of dental caries was also investigated so that the mean dmft+DMFT was 4.38 in this study. The mean dmft+DMFT in 6-11 years old Canadian children and 7-16 years old Qatari people was 2.47 and 4.29, respectively. This difference can be related to different diets, fluoride-containing drinking water and other local fluoride sources, and observing oral health. Furthermore, evidence shows that the mean vitamin D level is the same in toddlers and infants without a significant difference in primary school children. Knowing that vitamin D level does not significantly change in childhood, it can be concluded that the current vitamin D level indicates the vitamin D level in the past (teeth formation). Although the literature shows the role of vitamin D in preventing dental caries, limited studies with contradictory results have been conducted in this area, necessitating acquiring more information in this regard due to the high prevalence of dental caries in children. In most cases, the dental indexes in the sufficient vitamin D group were lower than those with deficient and insufficient vitamin D levels, but the difference was not statistically significant. However, the indexes D and DMFT in the 6-8 years old children with deficient and insufficient vitamin D levels were significantly higher than those with sufficient vitamin D level, unlike the conclusion of a similar study on 7-16 Qatari people. A significant relationship was found between dental caries and vitamin D deficiency in Qatari people. This difference can be justified given the different age ranges in these two studies. In our study, canines and permanent premolars have recently erupted, and the likelihood of dental caries was low. However, in the study on Qatari people, the probability of dental caries in 12-16 years old was higher due to the cumulative effect of time. Moreover, the vitamin D level may change with increasing age (13-15).

Unlike our study, the results of a study on 6-11 years old Canadian children show a significant relationship between the lower vitamin D serum level and dental caries. This difference can be related to the different latitudes of Iran and Canada and thus (16, 17), exposure to solar radiation and better dental health in Canada. The mean dmft+DMFT in 6-11 years old Canadian children was 2.47 but was 4.38 in our study.

Unlike our study, the results of several studies on the relationship between the vitamin D and calcium levels with dental caries showed a significant relationship between dental caries with vitamin D and calcium levels so that children with premature childhood dental caries (S-ECC) showed lower calcium and albumin and higher PTH levels. This difference can be related to the fact that children with S-ECC may suffer from a dental toothache that influences their daily eating habits, causing them to avoid eating. As a result, children with premature childhood dental caries had a relatively poor nutritional status than the control group without dental caries, which may be affecting the vitamin D, calcium, albumin, and PTH levels (18,19).

Conclusion

This study showed no significant relationship between the calcium and vitamin D levels with dental caries in 6-12 years old children.

Authors' contribution

LS is the single author of the manuscript.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical issues

The research followed the tenets of the Declaration of Helsinki. This study has been approved by the ethics committee of Tabriz University of Medical Sciences (Ethical code #IR.TBZMED.REC.1400.1228). Informed consent was obtained from all study participants. Besides, ethical issues (including plagiarism, data fabrication and double publication) have been completely observed by the authors too.

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