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Serum Vitamin D Level and Female Teenage Caries Experience

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ABSTRACT

Introduction: This study aimed to assess Serum Vitamin D level and female teenage caries experience.

Materials and Methods: This study evaluated 330 healthy female Iranian students between 13 to 19 years residing in Rey city. A questionnaire collected their demographic information. They underwent clinical dental examination to determine the number of decayed (D), missing (M) and filled (F) teeth (DMFT index). The nutritional status was evaluated using the food frequency questionnaire (FFQ) by assessing the consumption of cariostatic, cariogenic, remineralizing, sticky foods and carbohydrates. The serum samples were collected to measure the serum vitamin D level using high-performance liquid chromatography (HPLC). Data were analyzed by multiple logistic regression and independent samples t-test.

Results: The mean DMFT was 5.34±3.94. of all, 69.3% had severe vitamin D deficiency, 20.3% had moderate vitamin D deficiency and 10.4% had normal level of vitamin D. Cariostatic agents consumption had a significant inverse correlation with DMFT (P=0.006). An increase in serum level of vitamin D by more than 10.27ng/mL was associated with a reduction in prevalence of dental caries by 22%. Increased consumption of cariostatic agents by more than 89.30g/day decreased the prevalence of dental caries by 32%. No significant association was noted between the prevalence of dental caries and level of parent's education, consanguinity of parents, level of income, place of residence, frequency of tooth brushing, dental flossing, and dental visits (P>0.05).

Conclusion: While the serum vitamin D level had no significant effect on DMFT, the nutritional regimen seemed to play a more important role in caries control.

Keywords: Vitamin D; Caries; Female; Teenagers; Cariostatic.

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Introduction

Oral health has a direct effect on the general health and social well-being of individuals. Dental caries remains a common chronic disease in children and adolescents, which can compromise the quality of mastication, speech and daily activities, and decrease the quality of life of individuals if left untreated [1,2]. DMFT is the most efficient epidemiological index for assessment of dental caries [3]. According to the World Health Organization, the mean DMFT is variable in different countries. For instance, the DMFT index of 15-year-olds in Lebanon, Kuwait and Pakistan is 5.4, 3.9 and 1.54, respectively [4].

According to a study by Rabbani et al, [3] this index is 3.33 in 15-year-olds in Iran, which increases to 6.5 by the age of 17 years. Rezaei-Soufi et al. [4] reported the DMFT to be 3.35 for 13 to 19-year-olds. Considering the high prevalence of caries, attempts are still ongoing to find caries preventive strategies to increase the quality of life of patients and decrease the related costs of treatment. Caries development is a dynamic process that occurs following an imbalance in the equilibrium between the tooth structure and dental plaque, which leads to demineralization upon a pH drop [5]. High consumption of sugary foods and drinks and not adhering to oral hygiene measures can shift the equilibrium to demineralization and formation of caries [6].

Socioeconomic, behavioral, genetic and microbial issues can interact together to cause caries. Behavioral factors contain of quality and quantity of diet, dental hygiene, behavioral patterns or lifestyles related to society and culture. The most potential changeable risk factors in caries control are dietary and behavioral risk factors [7]. Some kinds of foods have more tendency to grow the mouth bacterial result that leads to plaque accumulation and causing tooth caries [8]. So, evaluation of these factors especially dietary habits to identify the link between dental caries and them is essential. Currently, several self-reported and objective nutritional tools are used for evaluating nutritional intake. Nutritional biomarkers are categorized in objective instruments which was the choice for assessment of micronutrient intakes. self- reported nutritional tools are divided into two categories short-term methods and long-term methods. Each method has definite benefits and drawbacks. Food Frequency Questionnaire (FFQ) is the most commonly used tool to evaluate dietary intake in epidemiological research for studying nutrition and disease disorders. This tool is more valuable than measuring other self-reported dietary that compare intake of foods in a few days [9]. Vitamin D is a fat-soluble vitamin, which can be produced endogenously or obtained exogenously via the consumption of certain foods or supplements [5]. It affects the uptake of calcium and phosphorous in the intestines, kidneys, and bone, and decreases the excretion of calcium and phosphorus by the kidneys [11]. Thus, it plays a fundamental role in the hemostasis of calcium and phosphorus and is required for hard tissue mineralization. Since ameloblasts and odontoblasts are the target cells for the active form of vitamin D, they play a fundamental role in the formation of enamel, dentin and bone [12]. The first report regarding the effect of vitamin D on tooth structure dates back to 1930 when a study showed a direct correlation between the prevalence of dental caries in 12 to 14-year-old Caucasian boys and their duration of exposure to sunlight [13]. Some national health surveys indicate that vitamin D insufficiency is a risk factor of dental caries in children and adults [14].

The exact mechanism of action of vitamin D in caries prevention is not yet clear. However, some suggested theories discuss improved calcium metabolism and dental development, enhanced remineralization of tooth structure, a topical effect similar to that of fluoride, change in biochemical composition of saliva and inhibiting the progression of caries by induction of immunological factors such as cathelicidin and defensin peptides that eliminate the cariogenic bacteria [15-18]. Several studies have assessed the effect of vitamin D on caries [15-32]. Brown et al, [19] Schroth et al, [22-24] Bener et al, [15] and Wójcik et al. [32] found a positive relationship between the serum level of vitamin D and decreased prevalence of dental caries. However, Herzog et al. [16] failed to find a significant association between vitamin D and caries.

Kim et al, [29] Gyll et al, [28] and van der Tas et al. [31] found an inconclusive relationship between vitamin D and caries and called for further investigations on this topic. Previous studies on the relationship between vitamin D and dental caries have been conducted on different age groups with variable methodologies, yielding controversial results. So, more study is essential to know the relationship between serum 25 (OH) D and caries experience. To date, search of the literature by the authors yielded no study on the vitamin D serum level of Iranian females between 13 to 19 years and its association with dental caries. Thus, this cross-sectional study was designed to assess the serum level of vitamin D in Iranian female teenage caries experience.

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Materials and Methods

Study Population

This cross-sectional study evaluated Iranian female students between 13 to 19 years residing in Rey City. The sample size was calculated to be 165 assuming a correlation coefficient of minimally 0.3 [29] (between vitamin D serum level and DMFT), study power of 90%, and type one error of 5%. Considering the cluster sampling method, the design effect was considered to be 2. Thus, the final sample size was calculated to be 330 students. The Ethics Committee of TUMS also approved the study protocol (IR.TUMS.VER.REC1395.1707). After obtaining approval from the authorities, the list of all-girl middle schools and high schools in two districts of Rey City was obtained from the Ministry of Education and Training, and two middle schools and two high schools were randomly selected using a table of random numbers. Next, one classroom was randomly selected from each school. The parents of 500 students were contacted, and the study objectives were thoroughly explained to them. Of all, parents of 330 students consented to the participation of their children in the study. The students had to be systemically healthy and willing to participate in the study.

Methodology

First, the students and their parents were provided with a demographic questionnaire and were requested to fill it out. Next, eight calibrated and trained interviewers filled out FFQ for students. This questionnaire evaluates the consumption pattern of 147 nutrients in detail [33]. To assess the effect of nutrients on dental caries, food products had to be divided into different groups to assess the relationship of each group with development of dental caries. For this purpose, after consultation with a nutritionist and based on the available literature [34-38], food products were categorized into the following five groups: carbohydrates, cariogenic foods, cariostatic foods, remineralizing foods, and sticky foods. Some explanation is expressed below:

1- Remineralizing foods: Low-fat milk, high-fat milk, yogurt, cheese, cream cheese, buttermilk, curd, and tea.

2- Sticky foods: Potatoes, Biscuits, Crackers, Packed Cakes, Pizza, Dried Figs, Dates, Bananas, Raisins, Dried Berries, Apricot Sheets, Quotes, Fresh and Dried Sweets, Cocoa Chocolate, Chips.

3- Cariostatic foods: Corn, beef and veal, chicken, fish, eggs, margarine butter, lettuce, tomatoes, cucumbers, cooked carrots, garlic, raw onions, cabbage, bell peppers, green peppers, oils, almonds, peanuts, pistachios, hazelnut, walnut.

4- Cariogenic foods: Bread, rice, macaroni, baked potatoes, fried potatoes, noodles, crackers, biscuits, packed cakes, lentils, beans, peas, baked beans, ice cream, red sauce, cantaloupe, watermelon, pear, apricot, Melon, Grape, Kiwi, Grapefruit, Portugal, Persimmon, Tangerine, Pomegranate, apple juice, raisins, fresh berries, dried berries, apricot leaves, fruit compote, packaged fruit juice, sugar, citrus, honey, jam, soft drinks, sweets, cocoa chocolate, coffee, lemon juice, candy. Afterward, the students underwent clinical dental examination by an operative dentist using the World Health Organization standard criteria [39]. Next, the D (decayed teeth), M (missing teeth), and F (filled teeth) components and the DMFT index were recorded for each patient [39].

The students were then briefed about their oral and dental condition and referred to the dental clinic of Tehran University of Medical Sciences in case of requiring treatment. Next, the students were referred for blood sample collection to determine their serum level of vitamin D. To prevent a drop in the blood glucose level of students, they were provided with a cookie and juice before testing. Blood samples (0.5mL) were collected from students and their serum level of vitamin D was measured by high-performance liquid chromatography (HPLC). The vitamin D levels were classified into the following categories [30]: (Sufficiency≥30 ng/mL, Insufficiency=21 to 29ng/mL, Deficiency≤ 20 ng/mL). The students were monitored for 20 minutes after blood collection and were then discharged. The parents were informed about the test results.

Statistical Analysis

Data are represented with mean and±standard deviation for numerical variables and frequency and percentage in parenthesis for categorical variables. The independent t-test was used to compare the level of vitamin D in two groups of DMFT. Multiple logistic regression models were used to estimate the effect of vitamin D and cariostatic foods on DMFT, adjusting for frequency of tooth brushing, dental flossing, dental visits, level of education of parents, level of income, consanguinity of parents, and place of residence. DMFT was considered as a binary variable in the t-test and logistic regression model. All statistical tests were two-sided and p-value less than 0.05 was considered as significant.

Results

The mean age of participants was 15±1.81 years. Table 1 presents the demographic information of participants and their parents based on DMFT. The mean DMFT index of students was 5.34±3.94. The mean D was 3.73±3.11, the mean F was 2.49±1.51 and the mean M was 0.49±0.10. For further analysis, DMFT was categorized as DMFT≤1 and DMFT≥2. The mean serum level of vitamin D was 17.161±10.274 ng/mL. The independent samples t-test showed an insignificant relationship between the serum level of vitamin D and DMFT groups (P=0.086). No significant association was noted between the DMFT components namely DT, MT and FT and serum level of vitamin D (P>0.05). No significant relationship was noted between the level of education of the father (P=0.373), level of education of the mother (P=0.176), consanguinity of parents (P=0.283), monthly family income (P=0.496), place of residence (P=0.123) and home ownership status (P=0.192) with DMFT of students. The frequency of tooth brushing (P=0.498), the frequency of dental flossing (P=0.101), the use of mouthwash (P=0.449), and the frequency of dental visits (P=0.767) had no significant association with DMFT either. The mean duration of exposure to sunlight per day (P=0.608) and place of residence (P=0.131) had no significant relationship with serum level of vitamin D. It should be noted that to analyze the nutritional intake, the nutritional category intakes were adjusted based on the calories received using the residual method. This was done to control for the effect of possible differences in energy intake. According to the frequency distribution of daily energy intake from each nutritional category namely cariogenic, cariostatic, carbohydrate, remineralizing and sticky foods, each group was qualitatively divided into three groups (tertiles) and the cut points of each group were tabulated (Table 2). However, among the nutritional items, consumption of cariostatic materials had a highly significant correlation with DMFT (P=0.006).

Table 3 shows the results of multiple logistic regression to assess the effect of vitamin D on DMFT by taking into account the effect of frequency of tooth brushing, dental flossing, dental visits, level of education of parents, level of income, consanguinity of parents, and place of residence. As shown, per one unit increase in the standard deviation of serum level of vitamin D (i.e. 10.27 ng/mL), the odds of caries (DMFT≥2) decreased by 22% (equal to the distance of odds ratio from 1, i.e. 0.22) and this was statistically significant. Per one unit increase in the standard deviation of consumption of cariostatic foods (i.e. 89.30 g/day), the odds of caries (DMFT≥2) decreased by 32% (equal to the distance of odds ratio from 1, i.e. 0.32). This effect was statistically significant (P=0.003), indicating that the effect of consumption of cariostatic agents on DMFT was greater than that of vitamin D.

Table 1. Demographic information of participants and their parents based on DMFT.

Variable	*DMFT≤1* *N (%)*	*DMFT≥2* *N (%)*
Level of education of mother		
Middle school or lower	*25 (7.57)*	*98 (29.69)*
High school	*33 (10)*	*131 (39.69)*
Bachelor's degree	*5 (1.51)*	*33 (9.69)*
Master's degree	*2 (0.6)*	*1 (0.3)*
Doctorate degree or higher	*0 (0)*	*2 (0.6)*
Level of education of father		
Middle school or lower	*26 (7.87)*	*109 (33.03)*
High school	*24 (7.27)*	*113 (34.24)*
Bachelor's degree	*14 (4.24)*	*32 (9.69)*
Master's degree	*3 (0.9)*	*8 (2.42)*
Doctorate degree or higher	*0 (0)*	*1 (0.3)*
Consanguinity of parents		
Yes	*30 (9.09)*	*102 (30.9)*
No	*35 (10.6)*	*163 (49.39)*
Monthly family income		

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Variable	DMFT≤1 N (%)	DMFT≥2 N (%)
<800,000T	21 (6.36)	58 (17.57)
800,000_1,500,000T	38 (11.51)	129 (39.09)
1,500,000_2,300,000T	6 (1.81)	45 (13.63)
2,300,000_3,000,000T	6 (1.81)	16 (4.84)
>3,000,000T	3 (0.9)	8 (2.42)
Place of residence		
Apartment/condominium	60 (18.18)	206 (62.42)
Townhouse	9 (2.72)	55 (16.66)
Home ownership status		
Rental	56 (16.96)	156 (47.27)
Owned	28 (8.48)	90 (27.27)
Tooth Brushing		
Never	0 (0)	1 (0.3)
Once a week	3 (0.9)	30 (9.09)
Once a day	42 (12.72)	153.36
Twice a day	15 (4.54)	62 (18.78)
After each meal	4 (1.21)	20 (6.06)
Dental Flossing		
Never	45 (13.63)	206 (62.42)
Once a month	0 (0)	5 (1.51)
Once a week	2 (0.6)	16 (4.84)
3 times a week	10 (3.03)	18 (5.45)
Once a day	6 (1.81)	22 (6.66)
Using mouthwash		
Never	53 (16.06)	234 (70.9)
Once a month	3 (0.9)	6 (1.81)
Once a week	3(0.9)	13 (3.93)
3 times a week	5 (1.51)	10 (3.03)
Once a day	0 (0)	3 (0.90)
Dental visits		
Never	2 (0.6)	14 (4.24)
When feel pain	49 (14.84)	185 (56.06)
Once a year	5 (1.51)	31 (9.39)
Every 6 months	5 (1.51)	16 (4.84)
Every 3 months	5 (1.51)	18 (5.45)
Daily exposure to sunshine		
Half an hour	23 (6.96)	91 (27.57)
1 hour	**24 (7.27)**	**85 (25.75)**
2 hours	14 (4.24)	48 (14.54)
3 hours and more	6 (1.81)	39 (11.81)

Table 2. Relationship of DMFT with the consumption of different nutritional groups.

Variable	DMFT≤1 N (%)	DMFT≥2 N (%)	P value
Cariostatic foods			0.006
<216.57 g/day	17 (26.5)	97 (35.3)	
216.57-279.40 g/day	14 (23.5)	97 (35.3)	
>279.40 g/day	24 (50.0)	81 (29.4)	
Carbohydrates			0.784
<281.11 g/day	24 (35.3)	84 (31.6)	
281.11-312.10 g/day	21 (30.9)	90 (34.9)	
>312.10 g/day	23 (33.8)	88 (33.5)	
Cariogenic foods			0.026
<1408.21 g/day	18 (26.5)	91 (34.9)	
1408.21-1967.79 g/day	18 (26.5)	90 (35.3)	
>1967.79 g/day	32 (47.0)	81(29.8)	
Remineralizing foods			0.136
<245.37 g/day	24 (35.3)	86 (32.8)	
245.37-326.71 g/day	28 (41.2)	84 (31.6)	
>326.71 g/day	16 (23.5)	92 (35.6)	
Sticky foods			0.127
<555.20 g/day	17 (25.0)	92 (35.6)	
555.20-1242.03 g/day	22 (32.4)	88 (33.5)	
>1242.03 g/day	29 (42.6)	82 (30.9)	

Table 3. Relationship of serum level of vitamin D and DMFT by taking into account the effect of frequency of toothbrushing, dental flossing, dental visits, level of education of parents, level of income, consanguinity of parents, and place of residence.

Variable	Odds ratio with (90%) confidence interval	P value
Consumption of cariostatic foods (standardized)	0.68 (0.52 -0.78)	0.003
Serum level of vitamin D (standardized)	0.78 (0.60 -1.01)	0.056

Discussion

This cross-sectional research aimed to assess serum Vitamin D levels and female teenage caries experience. The results showed an insignificant inverse relationship between the serum level of vitamin D and dental caries. This result was in line with the findings of some [16,25,28-31] and contrast to the results of some other studies [15,19,22,24,40]. Most studies on the relationship between vitamin D and dental caries had a cross-sectional design [15-17,20,25,28-32], and only three studies had a case-control design [24,30,40]. A previous study on the Iranian population reported a high prevalence of vitamin D deficiency in 13 to 19-year-old males and females [41]. On the other hand, the prevalence of dental caries among Iranian 13 to 19-year-olds according to the study by Rezaei-Soufi et al, [4] and Rabbani et al. [3] was much higher than the rate reported by the World Health Organization for this age group. Vitamin D deficiency is so high in many Asian countries which is considered an unrecognized epidemic situation [42]. As mentioned earlier, vitamin D is fat-soluble. Thus, the hormonal and growth changes that occur in girls at the age of 13 years can affect the metabolism of this vitamin, leading to the inefficacy of vitamin D supplements after the age of 13 years and their effects on dental caries [6]. Thus, 13 to 19-year-olds were evaluated in this study. The search of the literature by the authors yielded only three studies on individuals in an age group similar to the age group in our study [15,22,32]. Wojcik et al, [32] in Poland showed that by an increase in serum

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level of vitamin D by 10 ng/mL, DMFT decreased by 0.66 and DMFT total decreased by 0.82 in boys. However, in our study, with an increase in serum level of vitamin D by 10.27ng/mL, the prevalence of dental caries decreased by %22 in teenagers. This effect was marginally significant. Such an effect was not seen in urban areas. It should be noted that they evaluated 121 children between 6 to 17 years for one year, and their classification system for serum levels of vitamin D was slightly different from ours. Schroth et al. [22] assessed the relationship of caries and serum level of vitamin D. They classified the serum level of vitamin D as ≥75 nmol/L and ≥50 nmol/L. They found that the serum level of vitamin D ≥75 nmol/L decreased the odds of caries by 39% while the serum level of vitamin D ≥50 nmol/L decreased the odds of caries by 47%.

In their study, the odds of caries had a significant association with serum level of vitamin D even after adjusting for confounding factors such as the educational level of parents, tooth brushing twice a day, and annual dental visits using different regression models. Without adjusting for the confounders, the odds of caries were 0.57 for vitamin D serum level ≥75 nmol/L and 0.56 for vitamin D serum level ≥50 nmol/L. Also, multiple linear regression showed that dmft/DMFT was correlated with vitamin D serum level ≥75 nmol/L, absence of tooth brushing twice a day, low educational level of parents, and annual dental visits. The difference between their results and this study may be due to the fact that they classified patients as DMFT=0 and DMFT>0, which is different from our classification.

The mean DMFT/dmft was 2.09±2.84 in their study population while the mean DMFT was 5.34±3.94 in our study. Over half of their study population (56.4%) had DMFT/dmft≥ 1 while in our study, 19% of students had DMFT≤1 and 68% had DMFT≥2. Different classifications for vitamin D level and dental caries, differences in the adjusted confounders, and the high prevalence of caries in our study population may be responsible for different results. Bener et al. [15] reported that the prevalence of vitamin D deficiency was higher in patients with dental caries, especially females. They reported 59% frequency rate for DMFT≥1 versus 68% for DMFT≥2 in our study. After adjusting for the confounders, they reported that patients with vitamin D deficiency had 1.13 times higher risk of dental caries compared with those with normal vitamin D levels. They reported no significant difference in DT and MT between different age groups, which was in line with our findings. DMFT index is commonly used for assessment of caries [4,43,44] and was therefore used in our study as well as the abovementioned studies. However, its classification has been variable. To assess the pure effect of a factor, the role of confounders should also be taken into account. In the current study, we used a questionnaire to assess the effect of several factors on dental caries. Educational level of parents, family income, frequency of toothbrushing and dental flossing, use of mouthwash and annual dental visits had no significant relationship with the occurrence of dental caries. Concerning the level of education of parents, our findings were in agreement with those of Bener et al, [15] and Schroth et al [22]. Tanaka et al. [17] found a significant association between the level of education of parents and dental caries in other age groups while Schroth et al. [23] found no such association, which was similar to our findings. In our study, 22.4% of mothers and 16.8% of fathers had university education. Our results regarding the effect of the socioeconomic status of the family were different from those of Bener et al, [15] and Amiresmaili et al [45]. Bener et al, [15] and Schroth et al. [22] reported that tooth brushing twice a day significantly decreased the rate of caries. In the study by Bener et al, [15] children who brushed their teeth after each meal and those who brushed their teeth twice a day had significantly lower rates of caries, but no significant difference was noted between children brushing their teeth once a day and once a week, which was in line with our findings. However, in the study by Wójcik et al, [32] similar to our study, the frequency of toothbrushing had no significant effect on DMFT and DT.

Regarding dental flossing, our results agreed with those of Wójcik et al [32]. Regarding annual dental visits, the results of Schroth et al. [22] were different from our findings such that by an increase in the frequency of dental visits per year, the rate of dental caries increased in their study. However, the results of Wójcik et al. [32] aligned with our findings. Regarding the effect of nutrition on dental caries, it should be noted that not only the frequency of intake of carbohydrates, but also, their consistency, type, and processing in the oral cavity can all affect the trend of dental caries [46,47]. In contrast to previous studies that only assessed carbohydrate consumption with simple questions in a questionnaire or a 24-hour reminder, we used a 147-item questionnaire namely the FFQ. Also, we classified the foods based on the available nutritional and dental references [34-37,39] as carbohydrates, cariogenic foods, cariostatic foods, remineralizing foods, and sticky foods. Such a classification based on FFQ data has not been performed before and was a strength of

the current study. The results indicated that increasing the consumption of cariostatic foods significantly decreased dental caries (P=0.003). On the other hand, an inverse relationship was noted between the consumption of cariogenic foods and the prevalence of dental caries such that with an increase in the use of cariogenic agents, the rate of caries decreased. This finding may be due to the fact that consumption of cariogenic foods was high in our study population and number of foods in this category was higher and each of them had a different cariogenic property. According to Soliman et al, [38] rice, pasta, bread and tomato have lower cariogenic properties unless consumed in high amounts or processed a lot. It seems that the classification of cariogenic foods should be done with higher precision. This classification may explain the unexpected results obtained in this study because in this classification, all cariogenic foods, irrespective of their low or high cariogenicity, were categorized in one group. Consumption of foods in other categories (remineralizing foods, sticky foods and carbohydrates) had no significant effect on dental caries. Regarding carbohydrates, the results were in line with those of Schroth et al, [22] and Wójcik et al [32]. However, it should be noted that a simple questionnaire was used in both of the abovementioned studies to assess the consumption of carbohydrates.

Several classifications are available for vitamin D levels. Thus, studies on the effect of vitamin D on dental caries have used different classification systems [15,30-32]. Such a variability in classification systems is responsible for the controversy in the results and makes it impossible to compare our studies with those of previous studies. In our study, 69.3% of the study population had severe vitamin D deficiency, 20.3% had low level of vitamin D and 10.4% had normal level of vitamin D. In other words, 89.6% had serum level of vitamin D<30ng/mL. Evidence shows that vitamin D should have a concentration of 30 to 32ng/mL to effectively participate in extracellular activities [25]. On the other hand, Schroth et al. [23] reported that 75 to 100 ng/mL of vitamin D in serum is required to protect against caries. Another study reported that 30 to 40ng/mL serum level of vitamin D is required to effectively decrease the rate of caries [6]. Accordingly, only 10.4% of our study population had vitamin D serum levels sufficient for caries reduction. Thus, the obtained results were somehow predictable. About the environmental factors affecting the vitamin D level, we assessed the effect of exposure to sunlight during the day by asking the patients in this regard in the questionnaire. We also asked for the type of residence (condominium or townhouse) since this factor may also affect the exposure to sunlight. However, the results showed that none of these factors had a significant effect on serum level of vitamin D. This study had several strengths. All dental examinations were performed by one calibrated operative dentist. The serum level of vitamin D was measured as the gold standard and the nutritional regimen was assessed using the FFQ and by categorizing the foods into five categories.

The limitations of this study were as follows:

1. Radiography was not used to more precisely assess the presence of caries, which might have resulted in underestimation of the DMFT index.

2. Other factors affecting dental caries such as flow and consistency of the saliva and saliva level of Streptococcus mutans were not taken into account in this study. Thus, Future studies are required to assess the effect of serum level of vitamin D on tooth development and dental caries. Lastly, a causal association could not be revealed because this research was a cross-sectional study.

Conclusion

Within the limitations of this study and considering the obtained results, it may be stated that although a strongly significant relationship was not found between the serum level of vitamin D and dental caries, further studies are still required to cast a final judgment on this topic. However, nutritional components may have a greater effect on dental caries than vitamin D.

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Conflict of Interest

There is no conflict of interest to declare.

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