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Original Article

Association of Vitamin D Supplementation and Periodontitis in Iranian Adults: A Case-control Study

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ABSTRACT

Background and Objectives: Vitamin D may include a role in periodontal health. This study aimed to assess association of vitamin D supplement intake and periodontitis in Iranian adults.

Materials and Methods: This was a case-control study comprising 150 participants aged 35–44 years from the two sexes, who were non-smokers, non-diabetics and enquirers of dental treatment at a dental public health center. First, condition of periodontium was assessed using clinical attachment loss, probing depth, bleeding on probing and plaque index. Participants were grouped to normal (n_1 = 75) and chronic periodontitis (n_2 = 75) groups. Data on tooth brushing and flossing, body weight and height, history of periodontal treatment, regular dental visits, insurance status and regular vitamin D supplementation in past 3 y were collected using questionnaires. Chi square, t-student test and logistic regression were used for statistical analyses.

Results: Those who had regular vitamin D intake, experienced periodontitis less than those who did not (78.7% against 33.3%, P-value < 0.0001). Results of logistic regression analysis showed that after adjusting for all assessed variables, not taking vitamin D supplements (OR = 5.33) and brushing less than once a day (OR = 8.01) variables were independently associated to the development of periodontitis.

Conclusions: These results have shown that regular intake of vitamin D is independently linked to the periodontal health in adults.

Keywords: Periodontitis, Tooth brushing, Vitamin D, Supplement

Highlights

- Vitamin D may include a role in periodontal health.
- In this case-control study, those participants with regular vitamin D intake experienced periodontitis less than those who did not (78.7% against 33.3%, P-value < 0.0001).
- After adjusting for all assessed variables, not taking vitamin D supplements (OR = 5.33) and brushing less than once a day (OR = 8.01) variables were independently associated with the development of periodontitis.
- Optimizing vitamin D status through supplementation may be addressed as a preventive strategy against periodontitis.

Introduction

Vitamin D deficiency (VDD) is prevalent in developed and developing countries (1). Numerous studies in Iran have reported a high prevalence of VDD in various age groups (2–4). The major source of vitamin D for humans includes exposure of the skin to sunlight. Nevertheless, high occurrence of various degrees of VDD has been observed even in sunny regions (5). This can be due to several geographical and sociocultural factors, including latitude, air pollution, clothing types and skin color (6). Several evidence indicate an association of VDD with numerous human diseases, including cancers, diabetes, multiple sclerosis, immune system dysfunction, COVID-19 and cardiovascular diseases (CVD) (7, 8).

Chronic periodontitis is a multifactorial disease induced by an unbalanced interaction between the oral microbial and the individual inflammatory response (9, 10). It was

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estimated that in 2017, nearly 3.5 billion people suffered from oral diseases; of which, 796 million, mostly elderly people, had severe periodontitis as the leading cause of tooth loss (11). Biological (age), nutritional (high carbohydrate diets, obesity) and behavioral factors (smoking) are well-known risk factors (12–14). The onset of this disease is characterized by gum inflammation (gingivitis) and the disease progression results in loss of the supporting tissues of the teeth. If untreated, this ultimately leads to tooth loss (12).

In Iran, chronic periodontitis is the most prevalent oral health problem. Prevalence of periodontitis in Iranian adults reported by a national survey in 2018 was 55.5% (15). Relationship of vitamin D status, commonly investigated via assessment of the circulating 25-hydroxycalciferol [25(OH)D], on periodontal health has been interested (16, 17). Lower circulating 25(OH)D concentration is associated with impaired oral immunity and further aggressive forms of periodontitis (18, 19). Understanding modifiable risk factors of chronic periodontitis is essential for prevention and treatment of periodontitis. The present study aimed to investigate independent associations between vitamin D supplementation and periodontal status in Iranian adults.

Materials and Methods

Study design and setting

The current data were part of a case control study on determinants of chronic periodontitis carried out in School of Dentistry, Shahid Beheshti University of Medical Sciences and Health Services (SBMU), Tehran, Iran, February 2023 to November 2023. Associations between regular vitamin D supplement intake and periodontitis were assessed in a population of patients seeking dental care services in SBMU Dental Health Center, Tehran, Iran. In this study, regular intake of vitamin D was reported as intake of vitamin D pills on a daily, weekly, biweekly or monthly basis.

Sample size and study population

Sample size was calculated based on an earlier study on prevalence of periodontitis in Pakistan (20). Confidence interval (CI) was set at 95% and hypothetical proportion of controls were set with exposure of 56% and power of 80%. Calculated sample size included 150 participants (75 cases and 75 controls). In this study, convenience sampling was used. Exclusion criteria were as follows; history of periodontal surgeries, malignancy, pregnancy or lactation, diabetes mellitus, current or ex-smoking, continuous use of antibiotics for the past 6 m, immunosuppression and other diseases that may cause periodontitis. The case group (n_1 = 75; 35 males and 40 females) were patients with diagnosis of chronic periodontitis verified at the Department of Periodontology based on probing depth (PD), clinical attachment loss (CAL) and bleeding on probing (BOP). Case group comprised periodontitis patients, who showed PD ≥ 4 mm and CAL ≥ 3 mm in at least two teeth with BOP and at least 40% O'Leary plaque index (21). Controls (n_2 = 75; 35 males and 40 females) selected from the clinic were matched for age and sex. Control group included participants having PD < 3 mm, no CAL and at most 10% BOP (22).

Examination and data collection

A final-year student of dentistry was trained as examiner, who was responsible for filling out the patient's periodontal chart. Instruments used for examinations were as follows; #23 and #17 explorers, mouth mirror and William's probe. Walking probing method was used on six surfaces of each tooth (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual and distolingual) with appropriate force and angulation. O'Leary plaque index was calculated after staining the teeth with disclosing tablets (patients should not remove plaques in the past 2 h). Demographic and dental health data, including age, insurance coverage for dental care, oral health habits, regularity of dental visits, history of previous periodontal treatments (scaling and root planning) and regular consumption of vitamin D supplements, were collected using self-administered questionnaires. Body weight was measured to the nearest 0.1 kg with light clothing without shoes and height was measured to the nearest 0.5 cm under similar conditions. Body mass index (BMI) was calculated as the ratio of the individual's body weight (kg) to the square of height (m). Figure 1 schematically demonstrates the study protocol.

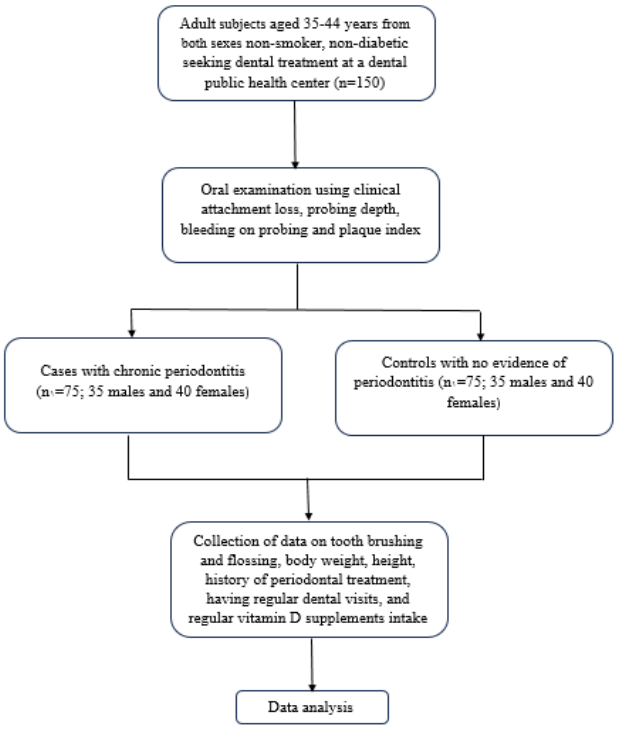


Figure 1. Flow diagram of the study protocol

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Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) v.26. Descriptive statistics were used for analysis and results were present as mean ±SD (standard deviation). Frequencies and percentages were generated for categorical variables. Chi-square and t-student test were used to compare categorical and continuous data, respectively. Logistic regression was used for multivariable analysis. A P-value less than 0.05 was recorded statistically significant.

Ethical issues

Written consents were collected from the participants after providing information on study objectives and the confidentiality of the participants' information through the study. This study was approved by the Committee of Ethics in Research Affairs of School of Dentistry, SBMU (ethical code, IR.SBMU.DRC.REC.1401.069).

Results

Variables, including age, oral health habits (brushing and flossing), BMI, regularity of dental visits, previous scaling and root planning (SRP) treatments, regular vitamin D supplement consumption and insurance status in cases and controls were compared using t-student and chi-square tests (Table 1). These data showed that mean age, brushing habits, regulatory of dental visits and consumption of vitamin D supplement significantly varied between the two groups.

Results of multiple logistic regression analysis in adjusted and unadjusted models indicated that after controlling for all assessed variables (including age), poor oral health (brushing less than once a day) and not taking vitamin D supplement were independently associated with the risk of periodontitis in this population (Table 2).

Table 1. Characteristics of the participants in case and control groups regarding age, insurance state, oral health habits, vitamin D supplement intake and anthropometric indices.

	Case (n=75)	Control (n=75)	P value
Gender			
Male	35	35	-
female	40	40	
Age (years; mean ± SD)	39.9±3.0	38.7 ±3.1	0.020
Insurance status (%)			
No insurance	26.7	12	0.6
Basic insurance	58.7	66.7	
Basic and supplementary insurance	14.6	21.3	
Brushing habits (%)			
Twice or more a day	22.7	45.9	<0.001
Once a day	52	50	
Less than once a day	25.3	4.1	
Flossing habits (%)			
Irregular	78.7	73	0.4
regular	21.3	27	
Regular dental visits (%)			
Irregular	93.3	66.7	<0.001
Regular	6.7	33.3	
Previous SRP treatment (%)	48	57.3	0.2
Regular vitamin D supplement intake (%)			
Yes	33.3	78.7	0.000
No	66.7	21.3	
Anthropometric indices			
BMI (kg/m^2)	27.2±4.9	26.4±4.6	0.3
Current weight (kg)	75.5±16.7	75.3±14.3	0.9
Original weight* (kg)	64.1±12.0	63.8±12.6	0.3

BMI: Body Mass Index; SRP: Scaling and root planning
*Original weight: body weight around age of 20 y

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Table 2. Associations between tooth brushing, regular dental visits, previous scaling and root planning treatments, vitamin D supplement intake and risk of periodontitis (age adjusted)

Variables	Crude		Adjusted	
	OR	CI (95%)	OR	CI (95%)
Brushing habits				
Twice a day and more	Ref			
Once a day	2.84	0.61-13.27	2.80	0.59-13.13
Less than once a day	**7.50**	**1.49-37.62**	**8.01**	**1.6-39.73**
Previous SRP treatment				
Yes	Ref			
No	1.4	0.55-3.85	1.5	0.57-3.94
Dental visits				
Regular	Ref			
irregular	3.09	0.81-11.77	2.68	0.76-9.64
Regular vitamin D supplement intake				
Yes	Ref			
No	**5.7**	**1.92-17.15**	**5.33**	**1.8-15.38**

CI: Confidence Interval; OR: Odd's Ratio; SRP: Scaling and Root Planning

Discussion

The present study indicated that after controlling for oral health habit, regular consumption of vitamin D supplement was negatively linked to developing periodontitis, independently. Results of previous studies on associations of vitamin D status in individuals with and without periodontal diseases were controversial (16, 17, 23). In a study carried out nearly two decades ago to assess the correlation of serum 25(OH)D concentrations and gingivitis on non-smoker patients of 13–90 y, an inverse linear correlation was detected between 25(OH) D concentration and gingival inflammation (24). Later, a meta-regression study on 780 postmenopausal women with tooth loss attributed to periodontal diseases reported an inverse correlation between serum 25(OH)D and periodontal problems, including tooth loss (25). In contrast, a cross-sectional study on non-smokers and non-diabetics in Finland verified no definitive links between serum concentrations of 25(OH)D, and development of pockets deeper than 4 mm and gingival bleeding in individuals at low-risks of periodontal diseases (26). A recent study on the assessment of the potential correlation between serum 25(OH)D concentrations and chronic periodontitis in postmenopausal women failed to show any significant relationship (27). A recent meta-analysis showed that vitamin D status was linked to periodontitis and concluded that vitamin D supplementation as an adjuvant to non-surgical therapy included a positive effect on prevention and treatment of periodontitis (28).

In the present study, no association were detected between BMI and periodontitis. Meta-analyses reported associations between obesity and weight gain with periodontitis (29, 30). Nevertheless, these associations might mostly be due to dietary habits leading to weight gain, including high intakes of free sugars, fats and alcohol. Further studies are necessary to clarify the possible relationship between body weight and periodontitis. Current evidence suggest that periodontitis is an inflammatory disease closely linked to autoimmune regulation and early recognition of inflammatory cytokines such as transforming growth factor (TGF)-β1. Moreover, vascular endothelial growth factor (VEGF) may be useful for the treatment and prognosis of periodontitis (31, 32). Vitamin D includes immunomodulatory, anti-inflammatory and anti-proliferative effects and plays an important role in bone metabolism, alveolar bone resorption and prevention of tooth loss (33–35). Vitamin D can decrease gingival inflammation and promote wound healing after periodontal surgery by strengthening the antibacterial defense of gingival epithelial cells. Hence, vitamin D supplementation for achieving sufficient status can be addressed as a prophylactic strategy against periodontal diseases (33). In addition, vitamin D includes a positive effect on periodontal wound healing after non-surgical periodontal treatment and an intervention trial showed that vitamin D supplementation improved CAL and PD after SRP (36). However, the present study included several limitations. Dietary intake of the participants was not assessed and vitamin D status of them was not assessed by measuring serum 25(OH)D concentration as well. Therefore, future studies are warranted to investigate relationships between vitamin D status and periodontal health based on dietary intakes.

Conclusion

In conclusion, regular vitamin D supplement consumption was detected protective against progression of periodontitis in Iranian adults.

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Abbreviations

BMI: Body mass index
BOP: Bleeding on probing
CAL: Clinical attachment loss
CI: Confidence interval
OR: Odds ratio
PD: Probing depth
SBMU: Shahid Beheshti University of Medical Sciences
SD: standard deviation
SPSS: Statistical Package for Social Sciences
SRP: Scaling and root planning
TGF-β1: Transforming growth factor
VDD: Vitamin D deficiency
VEGF: Vascular endothelial growth factor

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