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Association between Serum 25-Hydroxyvitamin D Concentrations and Periodontal Health

A Case-Control Study of Iraqi Men

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Abstract

Objective: To assess the relationship between serum 25(OH)D concentrations and periodontal health in Iraqi men. **Materials and Methods:** In this case–control study, 45 males aged (30-50) were involved. 25 patients considered as a case group with chronic periodontitis (stages III–IV), and 20 individuals with healthy periodontium counted as control group. Participants with systemic diseases, smoking, or vitamin D supplementation were excluded. Plaque index (PLI) and gingival index (GI) were obtained and serum 25(OH)D levels measured with Roche E411 analyzer. Vitamin D status was grouped as sufficient (≥20 ng/mL) or insufficient (<20 ng/mL, independent-samples t-tests, chi-square tests and Odds ratio (OR) were utilized for analysis. **Results:** PLI and GI were significantly greater in the periodontitis group ($p < 0.001$). Mean serum 25(OH)D level was more pronounced in the controls (15.05 ± 5.48 ng/mL) compared to periodontitis group (12.40 ± 6.70 ng/mL), but this difference was not significant ($p = 0.161$). Vitamin D insufficiency was frequent in both groups and more prevalent in periodontitis patients (OR = 2.67; $p = 0.423$). **Conclusion**: Serum 25(OH)D concentration showed no significant correlation with periodontal status. Larger and more varied populations are needed to clarify the relationship.

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Introduction

The main inflammatory condition of periodontium called Periodontitis, which considered as a chronic condition related to many factors which correlated with the gathering of biofilm, and connected to a massive destruction in the teeth-supporting tissues [1,2]. In this disease, there is afunctional reactions between certain bacterial pathogens and immune responses, as well as environmental factors [3].

The destruction in the periodontium including the alveolar bone occur because of interaction between the immunity of the host and the bacterial products [4]. Based on this tissue destruction, CP considered as a main source of losing teeth in grown up persons [5,6]. Losing of teeth that linked to periodontitis greatly influenced the life quality [7], dietary quality, and nutrient intake [8].

Up to 1 in 10 adults around the world may be smitten by severe periodontitis [9]. So, the mostly seeing type of periodontitis in the population is the chronic periodontitis (CP) [10]. Chronic inflammation of periodontal tissues occurred because of several proinflammatory incident in which both of adaptive and innate Immunity are participated [11].

Vitamin D considered as a fat-soluble type of vitamin created when a good amount of light from the sun directed to the skin, or from certain types of diet, then it will transform into (25 hydroxyvitamin D) into the liver. later on

at kidney it will change to its energetic state which is (1,25-hydroxyvitamin D) [12].
This vitamin participated in the intake and organizing of calcium homeostasis [13]. It has substantial roles in the overall health of the body. adequate amount of this vitamin is essential for maintaining good density of bone and minimizing the possibility of fracture [12,14].
Vitamin D considered insufficient if 25(OH)D < 20 ng/mL and sufficient if ≥20 ng/mL based on the National Academy of Medicine [15]. The deficiency and insufficiency of vitamin D had been mentioned in several studies all over the world, when serum level of vitamin D is lower than 25 nmol/L it will counted as deficiency it had been seen widely spread globally, particularly in India, Middle East, China, also small for gestational age infant, pregnant women and elderly considered as groups of hazards for deficiencies in vitamin D [16].
More recent evidence stated that vitamin D has an impact on the immunity, activate immune responses at a time and inhibit it at another [17].
Furthermore, vitamin D has important role in minimizing the serious effect of several chronic conditions, like autoimmune diseases, cardiovascular disease, cancers and infectious diseases. On the other hand, muscle weakness and osteomalacia may be associated with vit. D deficiency in adults [18].
Two large cross-sectional studies showed that there was connection among the depressed levels of vitamin D and periodontal diseases markers [19,20]. Also, two reports [12,21] showed a relationship between these two conditions. More recent studies conducted in 2023 revealed a connection among vitamin D and the advancement of gum disease and considered it as one of many hazard factors affecting periodontal health [22,23].
However, in 2014 the larger prospective study to date [24], as well as three more articles [14,25,26], revealed no association among the concentration of vitamin D and periodontal health.
The widespread presence of both vitamin D insufficiency and periodontal disease across many populations, together with the inconsistency of available evidence, highlights the necessity for further research in different ethnic and geographic settings. In Iraq, there is a considerable burden of periodontal disease, and vitamin D insufficiency is presumed to be highly prevalent; however, data on the relationship between serum 25(OH)D concentrations and periodontal health in Iraqi adults are sparse. In particular, there is a lack of studies focusing exclusively on male patients, who may exhibit differences from females in lifestyle, exposure patterns, and health-related behaviors.
Therefore, this case–control study was carried out to assess whether serum 25(OH)D concentrations are associated with periodontal health status in an Iraqi male population. Specifically, we evaluated differences in serum 25(OH)D levels and clinical periodontal parameters between males diagnosed with chronic periodontitis and periodontally healthy controls. We hypothesized that males with chronic periodontitis would exhibit lower serum 25(OH)D concentrations and a higher prevalence of vitamin D insufficiency than periodontally healthy males.

Material and Methods

Study design and setting
This study was structured as a case–control study including men with chronic periodontitis (cases) and men with clinically healthy periodontium (controls). All participants were selected from a dental center in Iraq. Data collection and clinical examinations were carried out in one setting under standardized conditions.
Participants and sampling
A total of 45 male participants were enrolled in the study. The sample composed of 25 males diagnosed with chronic periodontitis (stage 3 and 4) based on classification conducted at 2017 [2] and 20 males with clinically healthy periodontium.
Participants were recruited through convenience sampling from patients attending the dental center. A structured form was used to document basic background and medical information concerning eligibility and periodontal status.
Inclusion and exclusion criteria
The case group included males with chronic periodontitis, characterized by periodontal pocketing and loss of periodontal attachment affecting multiple teeth. The control group involved males with no clinical signs of periodontal inflammation and no history of periodontal treatment, and who showed healthy gingival status and physiologic sulcus depth on examination.
The following groups of participants were excluded from the study: females, patients with systemic diseases that might impact periodontal status or vitamin D metabolism (e.g., diabetes mellitus), current smokers, and individuals with previous vitamin D supplementation or medications that influence bone or mineral metabolism.
Only participants fulfilling the inclusion criteria and free from any exclusion criteria were included in the study.
Clinical examination and periodontal indices
All participants had a standardized intraoral clinical examination. Periodontal status was rated using Plaque Index (PLI) and Gingival Index (GI)
In order to minimize inter-examiner variability, the indices were recorded by the same examiner. The mean PLI and GI values were quantified for each participant and used for comparisons between case and control group.
Serum vitamin D assessment
For biochemical evaluation, ten millilitres of venous blood were obtained from each participant under aseptic conditions. serum was obtained from blood samples, which was then analyzed for 25-hydroxyvitamin D [25(OH)D] concentration. All analyses were performed in a single diagnostic laboratory using a Roche E411 analyzer, following the manufacturer's instructions, to ensure analytical consistency. Serum 25(OH)D concentrations were reported in ng/mL. In accordance with
the National Academy of Medicine classification, vitamin D status was sorted as:
Insufficient: 25(OH)D < 20 ng/mL
Sufficient: 25(OH)D ≥ 20 ng/mL
These categories were applied in the analysis to compare the prevalence of vitamin D insufficiency between the case and control groups.
Statistical analysis
A standard statistical software package was used for data analysis. Continuous variables (PLI, GI, and serum 25(OH)D concentration) were presented as mean ± standard deviation. Comparisons between the chronic periodontitis group and the control group were carried out using independent-samples t-tests for continuous variables.
For Vitamin D assessment chi-square tests were applied to compare its distribution between groups. The odds ratio (OR) with 95% confidence interval (CI) was computed to assess the association between vitamin D insufficiency and chronic periodontitis. A p-value < 0.05 was considered statistically significant.
Ethical considerations
The protocol for this study was evaluated and approved by the [university of Anbar] Ethics Committee (approval no. 15), and All participants provided written informed consent, in line with the Declaration of Helsinki.

Results

Participant distribution
An overall sample of 45 males were retained for the analysis, including 25 cases with chronic periodontitis (CP) and 20 controls with healthy periodontium. All participants fulfilled the eligibility criteria, and no additional participants were excluded after enrolment.

Plaque and gingival indices

Table 1 summarizes the comparisons in plaque and gingival indices between the two groups. Both PLI and GI values were substantially higher in the CP group than in controls. The mean PLI and GI in the CP group was 2.02 ± 0.28 and 2.01 ± 0.15, compared with 0.06 ± 0.04 and 0.05 ± 0.04 in the control group. For both indices, these differences were statistically significant different (t = 30.423 and 56.033, respectively; and p < 0.001 in both comparisons).

Serum 25-hydroxyvitamin D concentrations

Mean serum 25-hydroxyvitamin D [25(OH)D] levels are reported in Table 2 and the control group showed a higher mean 25(OH)D concentration than the CP group (15.05 ± 5.48 ng/mL) and (12.40 ± 6.70 ng/mL), respectively. Even though the numerical difference in vitamin D levels were more advantageous for periodontally healthy controls, this difference was not statistically significant (t = –1.427; p = 0.161).

Vitamin D sufficiency status and its association with chronic periodontitis

The distribution of vitamin D sufficiency status (insufficient or sufficient) in relation to periodontal condition is shown in Table 3. Among 20 men in the control group, 18 (90.0%) had vitamin D insufficiency, while only 2 (10.0%) recorded with sufficient levels. on the other hand, 24 out of 25 men (96.0%) in the CP patients showed vitamin D insufficiency, and only 1 (4.0%) had sufficient levels. Based on previous results, 42.9% of controls had vitamin D insufficiency and 57.1% were CP patients. Although vitamin D insufficiency was highly frequent in both groups, no significant association recorded between vitamin D status and periodontal condition. The odds ratio (OR) for chronic periodontitis in participants with vitamin D insufficiency, compared with those with adequate vitamin D levels, was 2.667 with a 95% confidence interval of 0.224–31.749 and a p-value of 0.423 (chi-square = 0.643), indicating a non-significant relationship.

Discussion

The current case–control research evaluated the link between serum 25-hydroxyvitamin D [25(OH)D] levels and periodontal health in Iraqi men. In this study the levels of plaque and gingival index was much more in chronic periodontitis group relative to control group this can be explained by the major effect of plaque in initiation and the advancement of periodontal disease [27]. Also, accumulation of dental plaque led to gingivitis and increasing in gingival inflammation [28]. In chronic periodontitis patients the gathering of dental biofilm results in elevation in the permeability of microvascular bed that will lead to more inflammation of gingiva [29]. Contrary to our hypothesis, men with chronic periodontitis did not show a statistically significant reduction in mean serum 25(OH)D levels compared with periodontally healthy controls. This results in agreement with previous work [25,30] that found a non-significant different between CP and control, and partly in agreement with data [31,32] that stated that the level of vitamin D fount to be elevated in control group but with significant difference which in disagreement with the presented study.

Based on vitamin D level, CP showed the foremost degree of insufficiency when compared to control group (odds ratio= 2.667) but with a non-significant difference between them (p=0.423).

These results could be supported by several studies, such as [24], which showed an association between vitamin D and periodontal health conditions in the largest and the longest longitudinal study we found. This study was carried out in 5 years by monitoring the change in periodontal parameters and comparing it with the concentrations of 25(OH)D at the baseline, they found non-significant associations between these two entities [24]. A cross-sectional study conducted on 1262 samples also recorded non- significant relevance among 25(OH)D and periodontal disease [33]. Furthermore, this result agrees with previous work [14,26,34,35] that found that there is no correlation among vitamin D and CP.

Various factors may underline our inability to detect a statistically significant difference in serum 25(OH)D levels among chronic periodontitis and control patients. First, the sample size was relatively small (only 45 subjects), which limits statistical power and increases the probability of type II error, especially when the actual effect size is modest. This is manifested in the wide confidence interval surrounding the odds ratio for vitamin D insufficiency. Second, vitamin D insufficiency was highly prevalent in both groups, leading to a narrow range of vitamin D values and reducing contrast between cases and controls. Third, only male subjects were included, which enhances internal homogeneity but restrict the exploration of sex-related differences and limits external validity. Moreover, potential residual confounders—such as nutrition-related habits, body mass index, outdoor activity, clothing style, and season of blood collection—were not adequately controlled, and these factors may affect both vitamin D status and periodontal health.

Despite these limitations, the present study exhibits several strengths. All individuals were assessed in a single center under standardized clinical conditions, and periodontal conditions was evaluated using well-established indices (PLI and GI). Biochemical assessment of serum 25(OH)D was performed in a single diagnostic laboratory using a uniform analytical method, minimizing measurement variability. Furthermore, the focus on a specific, relatively homogeneous group of Iraqi men reduces sex-related variability and major ethnic differences and provides initial information regarding this under-represented population.

However, several important limitations must be recognized. The case–control design is inherently observational approach and does not allow for causal inferences to be drawn regarding the relationship between vitamin D status and chronic periodontitis. As previously mentioned, the limited sample size and the high burden of vitamin D insufficiency presence in both groups limit the statistical power and the capacity to detect subtle relationships. Furthermore, only one serum 25(OH)D measurement was obtained, which may not adequately represent long-term vitamin D status, particularly in regions with seasonal variation in sunlight exposure.

Conclusion

Among Iraqi men, serum 25-hydroxyvitamin D [25(OH)D] concentrations were not significantly associated with chronic periodontitis. A high prevalence of vitamin D insufficiency was observed in both the case and control groups, indicating that vitamin D levels by itself may not be a primary determinant of periodontal health in this sample. Further larger studies are required to clarify this relationship in Iraqi populations.

Author Contributions

Lara Kusrat Hussein: Conceptualization; Methodology; Data curation (data collection); Formal analysis (data analysis); Writing—original draft.

Suha Aswad Dahash: Data curation (assisted data collection); Literature review; Writing—review & editing.

Sura Yaseen Khudhur: Formal analysis (assisted data analysis); Interpretation of results; Writing—review & editing (manuscript revision).

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Conflict of Interest

The authors declare no conflicts of interest.

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Table 1. The comparisons between the two groups based on their mean values of PLI and GI.

Parameter	Groups	N	Mean	Std. Deviation	t	Sig. (2-tailed)
PLI	CP	25	2.0188	0.28440	30.423	0.000
PLI	control	20	0.0645	0.03993	30.423	0.000
GI	CP	25	2.0080	0.15270	56.033	0.000
GI	control	20	0.0505	0.03517	56.033	0.000

Table 2. Comparisons between CP and control groups based on mean serum 25(OH)D concentrations (ng/mL).

Parameter	Groups	N	Mean	Std. Deviation	t	Sig. (2-tailed)
vit.D	CP	25	12.4000	6.69577	-1.427	0.161
vit.D	control	20	15.0500	5.48179	-1.427	0.161

Table 3. Levels of vitamin D based on periodontal conditions (C.P and control groups).

95% CI	OR	P-value	Chi-square	Total	control	C.P	Vitamin D	Vitamin D
95% CI	OR	P-value	Chi-square	N=45	N=20	N=25	Vitamin D	Vitamin D
0.224-31.749	2.667	0.423	0.643	39	18	24	No.	Insufficient
0.224-31.749	2.667	0.423	0.643	100%	42.9%	57.1%	%	Insufficient
0.224-31.749	2.667	0.423	0.643	6	2	1	No.	sufficient
0.224-31.749	2.667	0.423	0.643	100%	66.7%	33.3%	%	sufficient