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Original Article

Effect of Serum Vitamin D Levels on the Severity of Periodontal Disease: A Comparative Study

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ABSTRACT

***Objective*:** To compare mean serum vitamin D levels between patients with periodontitis and subjects with healthy periodontium and to determine the association of serum vitamin D levels with periodontitis

***Study Design*:** Comparative cross sectional study

***Place and Duration of Study*:** Periodontology Department, Institute of Dentistry, CMH Medical and Dental College, Lahore Pakistan, from Mar to Aug 2023.

***Methodology*:** Thirty-eight cases diagnosed with periodontitis and 38 age and gender matched controls with healthy periodontium were selected. Subjects were screened for periodontitis. Periodontitis was classified according to the extent of probing depth, radiographic bone loss, and clinical attachment loss. Blood samples were taken to evaluate vitamin D3 levels.

***Results*:** Deficient serum vitamin D3 levels, i.e., <30ng/ml, were observed in 76.3% subjects. Mean serum vitamin D3 levels were 29.07±16.08 ng/ml. A statistically significant mean difference in serum vitamin D levels between patients and controls was observed (p<0.001). Association between periodontitis and low serum vitamin D3 levels was also significant, with all cases showing low serum vitamin D levels (p<0.001).

***Conclusion*:** The difference in mean serum vitamin D3 levels between periodontitis patients and controls was statistically significant (p<0.001). A significant association between periodontitis and low serum vitamin D levels was observed, with all cases showing low serum vitamin D levels (p<0.001).

Keywords: Clinical Attachment Loss, Periodontitis, Periodontal Disease, Vitamin D.

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INTRODUCTION

Vitamin D represents a cluster of "fat-soluble hormones" that play a vital role in metabolism of calcium and phosphate, affecting bone homeostasis as well as modulation of immune system.[1] The anti-inflammatory and antimicrobial characteristics of vitamin D help it in achieving its biological functions.[2] It can be sourced via diet through some natural products including oily fish, mushrooms and egg yolks but its primary source is synthesis via dermal exposure to sunlight.[3]

Globally, awareness regarding vitamin D deficiency (VDD) and its profound effects on one's health has increased remarkably over the last decade. It has been reported that around 1 billion of the world population may be suffering from VDD.[4] Risk groups for severe VDD (<30 nmol/L) include exclusively breast-fed infants, children and adolescents, pregnant females, elderly especially those with any disability, expatriates and refugees.[5] Results of a recent study done on South Asian adults population VDD prevalent in 73% of Pakistani population and 67% in Bangladeshi adults.[6]

Literature proposes that low serum vitamin D3 (SVD) may affect the severity of periodontitis.[7] Reports from European consensus have highlighted a negative impact of a poor diet and low SVD levels on oral-dental health, especially periodontium.[8] Periodontitis refers to the chronic inflammation and subsequent deterioration of periodontium, i.e., tissues supporting the teeth. Ataullah *et al.*, have reported that periodontitis is prevalent in 71% of Pakistani adults.[9] In adults, periodontitis is the main etiological factor for tooth loss, adding considerably to the overall global burden of disease.[10]

Studies supporting as well as negating the effects of VDD on the severity of periodontitis exist in the literature. However, studies reporting on data from the local population are scarce. The present study aimed to compare SVD levels between subjects with periodontal disease and those with healthy periodontium in the local population. Results of the study will help customize periodontal screening and treatment for the population at risk.

METHODOLOGY

The comparative cross sectional study was conducted at the Periodontology Department, Institute

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of Dentistry, CMH Medical and Dental College, Lahore Pakistan. Approval from the Institutional Ethical Review Committee was sought (Letter no.643/ERC/CMH/LMC). Using the OpenEpi sample size calculator, keeping the frequency of VDD in subjects with periodontitis as 99%, and in healthy subjects as 79%.[11]

Inclusion Criteria: Subjects, aged 22 years or more, with at least 14 permanent teeth present in the oral cavity and no history of smoking or any chronic illness such as diabetes, depression, liver/kidney disease, or heart disease, reporting to the dental out patient department of CMH Lahore Institute of Dentistry were included in the study. Cases were subjects diagnosed with periodontitis, while controls were subjects with healthy periodontium.

Exclusion Criteria: Subjects who had recent vitamin D supplementation within the last 3 months, history of radiotherapy in the last 6 months, recent periodontal therapy, recent or ongoing orthodontic treatment, any oral pathology, as well as pregnancy, were excluded.

Informed consent was obtained from all participants, and their demographic details were recorded in a proforma. For every periodontitis patient enrolled in the case group, an age and gender matched healthy subject was enrolled in the control group. All subjects were screened for the presence of periodontitis. Clinical attachment loss (CAL) and probing depth (DP) were measured using Michigan O' Probe for at least 02 teeth per sextant. Standardized periapical radiographs were taken using using periapical radiograph DIGORA™ Optime DXR-60 digital intraoral imaging plate system (Soredex, NC, USA) with associated imaging software and measuring tool SCANORA™ and were used to assess radiographic bone loss (RBL) around teeth. Periodontitis was classified according to extent of PD, CAL and RBL as described by American Academy of Periodontology: "mild: 1-2 mm CAL, PD >3mm & <5mm, RBL <15% involving coronal third only, moderate: 3-4 mm CAL, PD ≥5mm & <7mm, RBL 15-33% involving corona third only and, severe: ≥5mm CAL, PD ≥7mm, RBL extending to mid-third of root and beyond"

Venous blood samples, about 5ml each, from both cases and controls were taken by a qualified Pathology lab technician for evaluation of SVD levels. Depending on the results, the subjects were categorized as deficient with SVD <30 ng/ml and sufficient with SVD ≥30 ng/ml.[12-14]

Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 24. Descriptive statistics were calculated. Quantitative variables such as age and SVD levels were depicted as mean±standard deviation, whereas frequency and percentages of categorical variables such as gender and periodontal status were calculated. A comparison of SVD levels, PD, RBL, and CAL between patients and controls was done via an independent sample t-test. The association between vitamin D status (deficient vs sufficient) and periodontitis was evaluated using a chi-squared test. For comparison of SVD levels between different stages of periodontitis according to severity, one-way ANOVA was used. For all statistical tests, *p*-value of ≤0.05 was considered significant.

RESULTS

Of the 76 study subjects, 44.7% (n=34) were males and 55.3% (n=42) were females, equally divided into case and control groups. The mean age of the study subjects was 35.39±7.51 years (range: 22-49 years).

Of the 38 periodontitis cases, 44.7% (n=17) were male subjects while 55.3% (n=21) were female subjects. The majority, i.e., 57.9% (n=22), were diagnosed with mild periodontitis (Figure). Mean CAL in the case group was 2.65±1.43 mm, whereas mean PD was 4.79±1.31 mm. Controls did not show any clinical attachment loss or radiographic bone loss, and their probing depths were also normal. Mean PD observed among controls was 2.11±0.45 mm.

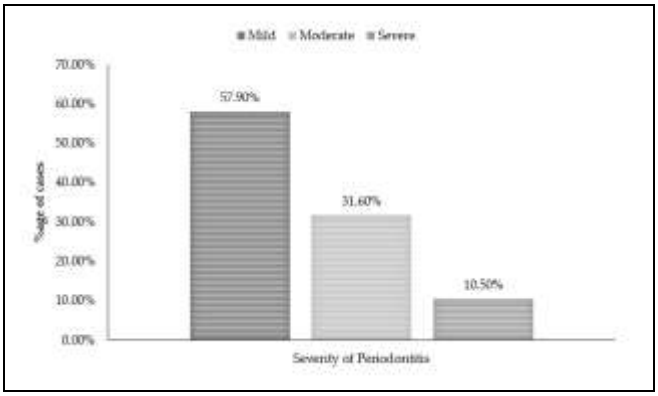

Figure: Distribution of Cases According to Severity of Disease (n=38)

Deficient SVD levels, i.e., <30ng/ml, were observed in 76.3% (n=58) study subjects, while only 23.7% (n=18) subjects had SVD levels >30ng/ml. Mean SVD levels of the study cohort were 29.07±16.08 ng/ml. Mean difference in SVD levels between

periodontitis patients and controls was statistically significant (p<0.001) as shown in Table-I. Likewise, mean CAL, PD and RBL were also significantly different between cases and controls (Table-I). However, no significant difference in mean SVD levels was seen between males and females (p=0.465) or between age groups, i.e., <35 years vs. ≥35 years (p=0.87).

Table-I: Comparison of Mean Serum Vitamin D Levels, Clinical Attachment Loss, Probing Depth and Radiographic Bone Loss between Cases and Controls (n=76)

Parameter	Cases n=38	Controls n=38	*p*-value
Serum Vitamin D Levels Mean±SD ng/ml	19.16±6.45	38.97±16.68	<0.001
Clinical Attachment Loss Mean±SD (mm)	2.64±1.43	-	-
Probing Depth Mean±SD (mm)	4.79±1.31	2.11±0.45	<0.001
Radiographic Bone Loss Mean±SD (mm)	2.81±1.53	-	-

Mean difference in SVD levels was also statistically significant for different stages of periodontitis (mild, moderate, severe) *(F(2,35)=24.49, p<0.001)* (Table-IIA). Significantly lower mean SVD levels in subjects with severe periodontitis (7.8±2.79 ng/ml, p=0.008) vs. moderate (16.02±2.43 ng/ml) and mild periodontitis (22.95±5.33 ng/ml, p<0.001), and subjects with moderate vs. mild periodontitis (p<0.001), suggesting a consistent decline in SVD levels with increasing disease severity (Table-IIB).

Table-IIa: Comparison of Serum Vitamin D levels between Different Stages of Periodontitis (n=76)

Parameters	Group-1: Mild Periodontitis (n=22)	Group-2: Moderate Periodontitis (n=12)	Group-3: Severe Periodontitis (n=04)	*p*-value
Serum vitamin D (ng/ml)	22.95±5.33	16.02±2.43	7.8±2.79	<0.001

Table-IIb: Inter-Group Comparison of Serum Vitamin D levels between different Stages of Periodontitis (n=76)

Group Comparison	Group-1 vs. Group-2 (*p*-value)	Group-2 vs. Group-3 (*p*-value)	Group-1 vs. Group-3 (*p*-value)
Serum vitamin D (ng/ml)	<0.001	0.008	<0.001

A significant association between periodontitis and low SVD levels was observed, with all cases showing low SVD levels (p<0.001) (Table-III). No significant association was found between periodontitis status with age and gender (p>0.05).

Table-III: Association of Periodontitis Status with Serum Vitamin D Levels (n=76)

Periodontitis	Serum Vitamin D Levels		*p*-value
	Deficient <30ng/ml	Sufficient ≥30ng/ml	
Present	38(50.0%)	0(0%)	<0.001
Absent	20(26.3%)	18(23.6%)	

DISCUSSION

There is increasing evidence that vitamin D3 is essential for the maintenance of periodontium, by inducing antimicrobial activity against the microbial biofilm as well as by suppressing cytokine production that ultimately causes bone resorption.[15,16] Hence, vitamin D has an overall protective effect on periodontium.[17]

In the current research, low SVD levels (<30 ng/ml) were observed in 76.3% subjects. This finding is endorsed by those of Arshad *et al.*,[18] who reported collective VDD (<20 ng/ml) and insufficiency (20-30 ng/ml) in 76% of the Pakistani population. Similar findings have been reported by Siddiqee *et al.*,[6] who documented VDD prevalent in 73% of the Pakistani adults. Likewise, Bhargava *et al.*,[19] reported VDD in 80% of the Indian population, and Madi *et al.*,[20] reported the exact prevalence (80%) in the Saudi population, which compares favorably with our results. Yussif *et al.*,[12] on the contrary, reported a higher frequency of 97% VDD in Egyptian subjects. This difference may be attributed to differences in ethnicity as well as extremely hot weather conditions in Egypt, which lead people to avoid going out in the sun.

The present research found consistently lower SVD levels in periodontitis cases (19.16±6.45 ng/ml) in comparison to healthy controls (38.97±16.68 ng/ml). Similar findings have been reported by Olszewska-Czyz *et al.*,[11] who reported lower SVD levels in periodontitis cases (31.34±5.62 ng/ml) vs controls (39.64±8.77 ng/ml). Significantly lower SVD levels in periodontitis patients (25.03±8.55 ng/ml) in comparison to healthy controls (29.19±12.82 ng/ml, p=0.03) have also been documented by Bhargava *et al.*,[19] also reported low SVD levels in patients with chronic periodontitis; however, they did not compare their findings against healthy controls. Likewise, lower SVD levels in chronic periodontitis subjects (17.4±5.2 ng/ml) as compared to healthy controls (29.9±5.4 ng/ml) were also reported by Isola *et al.*[13]

Moreover, in the current study, a significant association between periodontitis and low SVD levels

was observed, whereby mean SVD levels declined with increasing disease severity. This finding is endorsed by Olszewska-Czyz and Firkova,[11] who also reported decreasing SVD levels with increasing grade (severity) of periodontitis. Madi *et al.*,[20] reported increasing severity of periodontitis as demonstrated by loss of alveolar bone height with decreasing SVD levels. Isola *et al.*,[13] also reported a "proportional decrease" in SVD levels with an increase in all periodontal disease parameters, including CAL, PD, and bleeding sites. Although Millen *et al.*,[14] reported no association between SVD levels and periodontitis measured by bone and tooth loss, they did report "33% lower odds of having periodontal disease" in subjects with sufficient SVD levels.

Since the focus of interest in the present study, i.e., periodontitis and VDD, are both frequently encountered in the local population, hence, the study design was exceptionally well-suited to this research. Moreover, since data collection relied on objective measurements and not just patient history, recall bias did not affect the study results. At the same time, the study has its share of shortcomings. The sample size was relatively small and involved only a single center for subject selection. Future multi-center studies involving a larger and diverse sample are recommended. Moreover, the impact of supplementation with vitamin D3 on the prognosis of periodontitis should also be evaluated.

CONCLUSION

Deficient SVD levels (<30ng/ml) were observed in 76.3% of the study subjects. Mean difference in SVD levels between periodontitis patients and controls was statistically significant. A consistent decline in SVD levels was observed with increasing severity of periodontitis. A significant association between periodontitis and low SVD levels was observed, with all cases showing low SVD levels.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MT & MH: Data acquisition, data analysis, critical review, approval of the final version to be published.

MA & AW: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SR & NA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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