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Original Article

Vitamin D and periodontal health in postmenopausal women – an observational study

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Abstract

Menopause is considered a phase in a woman's life attributed to several changes in the body due to the deficiency in circulating estrogen. Decrease in estrogen levels are also associated with vitamin D deficiency, as estrogen is required for the activation of vitamin D. Vitamin D is essential in maintaining alveolar bone health. A deficiency of vitamin D could be associated with an increased risk of developing periodontal disease. With this background, the study was conducted to evaluate the salivary vitamin D level and periodontal health in postmenopausal women. A number of 70 systemically healthy postmenopausal women were included in the study. Periodontal parameters such as bleeding on probing (BOP), plaque index (PI), probing depth (PD) and clinical attachment level (CAL) were assessed. In addition, saliva samples were collected and evaluated for vitamin D levels using an ELISA kit. The data were then subjected to statistical analysis. The salivary vitamin D levels were found insufficient in the majority of the subjects (75.71%). Mean CAL was 2.89±0.79, the mean PD was 2.86±0.79, the PI score was 1.6±0.82 and BOP was 56.79±5.13. Only 37% of participants had good plaque scores. There was a strong negative correlation between the salivary vitamin D level and the periodontal clinical parameters, which was highly statistically significant ($p<0.01$). Postmenopausal women had insufficient levels of vitamin D and this, in turn, could have a negative impact and increase the risk for periodontal disease.

Keywords: postmenopause, vitamin D level, periodontal disease.

Introduction

Vitamin D is a secosteroid essential in maintaining skeletal integrity by playing an important role in bone mineralization and resorption [1, 2]. In addition, it also functions in calcium homeostasis by maintaining the calcium and phosphorous concentrations, regulates parathyroid hormone production, and has an important role in the islets of the pancreas [1, 3]. Furthermore, vitamin D is known for its anti-inflammatory properties, as it has the ability to inhibit cytokine production. It also causes monocytes and macrophages to secrete molecules that have a strong antibiotic effect [1]. Hence, vitamin D deficiency may be linked to the development of infectious diseases such as periodontitis [2].

Periodontitis is a biofilm-induced, chronic inflammatory disease affecting the tooth-supporting tissues – periodontium. It is influenced by a complex interplay of bacteria, host response to bacterial infection and other environmental and acquired risk factors [4, 5]. Vitamin D is known to have an effect on periodontal health as it directly affects bone metabolism and also has an antibiotic effect on periodontopathogens. The immunomodulatory effect of vitamin D is thought to regulate the mediators that contribute to periodontal destruction [1]. The production of estrogen by ovaries markedly diminishes following menopause. Consequently, it results in an increase in bone turnover, decreased bone mineral density and increased risk of fracture. Low estrogen levels are also linked with a deficiency of vitamin D [6, 7].

Vitamin D deficiency is considered a public health concern worldwide [8, 9]. Among them, postmenopausal women are at a higher risk of developing the condition due to an estrogen-deficient state. Evidence from previous studies indicates that vitamin D deficiency can predispose individuals to an increased risk of periodontal diseases [10]. Hence, the study aimed to evaluate vitamin D levels and periodontal health in postmenopausal women.

Material and methods

Study design

The study comprised 70 systemically healthy postmenopausal women recruited from the Department of Periodontics outpatient department. Informed consent was obtained from all the participants after explaining the nature and purpose of the study.

Study patients

Postmenopausal women in the age group of 50–65 years were included in the study. A minimum complement of twenty natural teeth was required for the inclusion. Women taking supplements or under hormone replacement therapy were excluded from the study.

A detailed history was taken for each patient, consisting of demographic details and past medical and dental history. Further, a complete intraoral examination was done using a mouth mirror and a UNC 15 probe. The clinical parameters recorded were:

- Bleeding on probing – According to the Gingival Bleeding Index, Ainamo and Bay, 1975, a percentage of total sites exhibiting bleeding [11];
- Plaque Index, as described by Silness J and Loe H in 1964. Scores were given as excellent, good, fair or poor [12];
- Pocket depth-measured using the UNC-15 probe as the distance from the gingival margin to the base of the sulcus [13];
- Clinical attachment level – From the cementoenamel junction to the base of the pocket [13].

Saliva samples were collected from each patient using the draining method to assess the vitamin D levels. Unstimulated saliva was collected by asking the patient to sit with the head bent down and mouth slightly open to allow the saliva to passively drip down the lower lip into the collection tube. The collected samples were then sent to the research lab and analysis was carried out using the Calbiotech Inc. salivary Vitamin D Enzyme-Linked Immunosorbent Assay (ELISA) kit.

Statistical analysis

Continuous data were recorded using mean and standard deviation. Categorical data was recorded in frequency and percentage. A p-value less than 0.05 was considered statistically significant. Spearman's correlation was used to correlate the salivary vitamin D level and the periodontal status.

Results

The study was carried out on 70 systemically healthy postmenopausal women to assess salivary vitamin D and periodontal health. Statistical analysis was carried out using Microsoft Excel and SPSS software version 25. The obtained results were interpreted using tables and graphs.

The population characteristics of the participants are depicted in Table 1. The mean age was 55.07±3.92 years and the mean duration of menopause was 5.17±3.16 years.

The salivary vitamin D levels were insufficient in 53 subjects (75.71%), deficient in 15 subjects (21.42%) and sufficient in 2 subjects (2.85%) (Table 2).

The findings from the subjects recorded a mean CAL of 2.89±0.79, mean PD of 2.86±0.79, PI score of 1.6±0.82 and BOP of 56.79±5.13 (Table 3). Only 37% of participants had good plaque scores (Figure 1).

The correlation between salivary vitamin D level and the periodontal clinical parameters was analyzed using Spearman's Correlation, which revealed a strong negative correlation that is highly statistically significant ($P<0.001$) (Table 4).

Discussion

Menopause is the physiological process that occurs in a woman's life that marks the transition from a fertile to an infertile period. It is identified as the time of the final menstrual period that is followed by twelve months of amenorrhea. Post-menopause is the phase following the final menses [14]. It occurs due to primary ovarian failure and is associated with alterations in the hypothalamic and pituitary hormones that regulate the cycle. Due to the depletion of ovarian follicles, the ovaries can no longer respond to follicle-stimulating hormone (FSH)

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Table 1: Population characteristics.

Variable (in years)	Min–max	Mean±SD
Age	50–64	55.07±3.92
Duration of menopause	1–13	5.17±3.16

Table 2: Salivary Vitamin D levels among the selected participants.

Vit D	Frequency	%
Deficient	15	21.42
Insufficient	53	75.71
Sufficient	2	2.85

Table 3: Periodontal status in postmenopausal women.

Variable	Min–max	Mean±SD
Mean CAL (mm)	1.9–4.5	2.89±0.79
Mean PD (mm)	1.8–4.5	2.86±0.79
PI (scores)	0.1–3.0	1.6±0.82
BOP (%)	51–66	56.79±5.13

and luteinizing hormone (LH). Hence, the production of estrogen and progesterone hormones is stopped [14].

The major consequences of menopause are related primarily to estrogen deficiency [14]. Estrogen deficiency is associated with a variety of manifestations in menopausal women. Calcium balance studies have shown that calcium absorption declines with menopause [10].

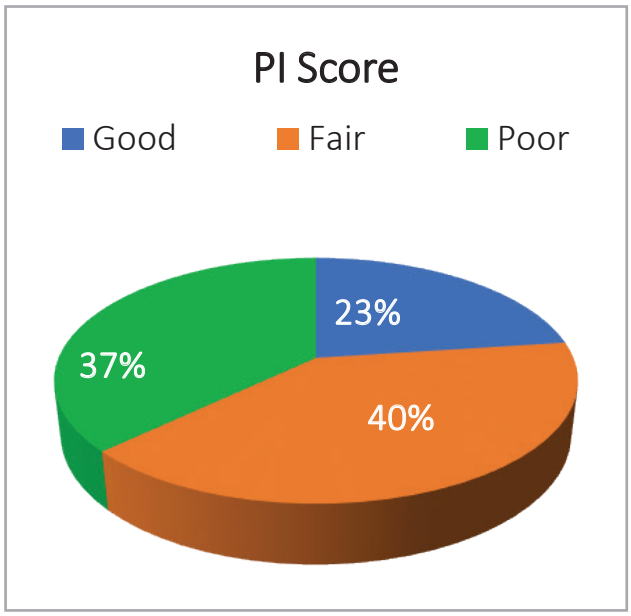

Figure 1: Pie chart depicting the PI scores of the participants.

It is known that estrogen plays an important role in the activation of Vitamin D by increasing the activity of 1alpha hydroxylase, which is expressed in the kidneys. It also upregulates the vitamin D Receptor (VDR).

Therefore, due to aging and a drop in estrogen levels in postmenopausal women, there is an increased possibility of developing vitamin D deficiency [6]. The postmenopausal women in this study also had insufficient salivary vitamin D levels (Table 2). This is in accordance with several other studies which also found inadequate vitamin D levels in postmenopausal women [15–18]. Other factors associated with low vitamin D levels include less exposure to sunlight, less intake of dietary vitamin D as well as supplements and aging.

Table 4: Correlation of salivary vitamin D level and periodontal status in postmenopausal women using Spearman Correlation.

Variable	Vitamin D	
	R-value	P-value
CAL	-0.726	<0.001*
PD	-0.726	<0.001*
PI	-0.811	<0.001*
BOP	-0.82	<0.001*

Note: * – Highly significant statistically.

The lack of sunlight exposure due to staying indoors and physiological aging can result in a higher prevalence of vitamin D deficiency [15].

Vitamin D deficiency in menopause is associated with several conditions, like increased risk of bone loss leading to osteoporosis, increased risk of cardiovascular disorders, and mood changes. In addition, the susceptibility to infections, including periodontitis, increases. Periodontal hemostasis involves the interplay of various factors, among which the endocrine system is of utmost importance. Sex hormones, including estrogen, progesterone and chorionic gonadotropin, are known to affect the circulatory system. Changes are observed in the form of enlargement of endothelial cells and pericytes of the venules, attachment of platelets to the wall of the vessels, microthrombi formation, destruction of mast cells, vascular proliferation and also an increase in vascular permeability [19].

Vitamin D functions as an anti-inflammatory and immune-modulatory agent by synthesizing cathelicidins and defensins from the gingival epithelium [20]. Optimal levels of Vitamin D suppress the activity of B and T cells and protect the periodontal tissues from an excessive immune response by decreasing the secretion of cytokines and interleukins. The release of cytokines causes infiltration of lymphocytes, alveolar bone resorption and destruction of the extracellular matrix [21].

The majority of the participants had a mean CAL between 2–3 mm (65.8%). The mean PPD was 2.86±0.79. In addition, the mean PI scores and BOP were 1.6±0.82 and 56.79±5.13, respectively (Table 3, Figure 1). These values indicate the presence of inflammation and poor oral hygiene condition of the participants, subsequently, the higher risk of developing periodontal disease. The mechanism of periodontal destruction can be explained as follows: The bacterial plaque biofilm is known to be associated with the production of lipopolysaccharide-released by-products. These stimulate the synthesis of inflammatory cytokines, activating the osteoclasts and leading to bone resorption. The inflammatory cytokines [interleukin 1 (IL-1), IL-8, IL-6, IL-10, tumor necrosis factor-alpha, granulocyte-macrophage colony-stimulating factor (GM-CSF)] alter the bone cell proliferation leading to resorption of skeletal and alveolar bones. It also triggers the tissue proteinases and degradative enzymes, which causes connective tissue destruction, resorption of alveolar bone and, finally, tooth loss [19]. Several studies have reported elevated levels of proinflammatory cytokine in menopausal women [22–24]. The results of this study are in accordance with other studies, where poor oral hygiene was recorded in postmenopausal women, leading to a detrimental impact on periodontal health [25–27].

A strong negative correlation was observed in comparing vitamin D level and periodontal status (Table 4). Vitamin D deficiency has been associated with an increased risk of chronic periodontitis [28–31]. Low vitamin D levels are found to inhibit periodontal tissue healing, which further aggravates the course of periodontal disease [29]. However, contrary to the present findings, some studies could not reveal the effects of vitamin D on periodontal health [32, 33]. This study has certain limitations, including the cross-sectional study design, the absence of radiographic assessment and categorizing the periodontal disease severity. Furthermore, the sunlight exposure of the participants and dietary intake of vitamin D was not assessed. Considering these limitations, it can be concluded that postmenopausal women are deficient in vitamin D, which could have an adverse effect on periodontal health.

Conclusion

Vitamin D deficiency is becoming a growing concern worldwide, especially among women in the postmenopausal phase and contributes to the development of periodontal disease. Within the limitations of this study, it can be concluded that postmenopausal women had insufficient levels of vitamin D and this, in turn, could have a negative impact and increase the risk for periodontal disease.

Therefore, it is necessary to create awareness among the general population and medical health professionals on the impact of vitamin D inadequacy on musculoskeletal as well as oral health and the role of an interdisciplinary approach in the health care of postmenopausal women. However, further long-term, prospective studies are required in the future to substantiate the above-mentioned findings.

Conflict of interest

The authors declare no conflict of interest.

Ethics approval

The approval for this study was obtained from the Ethics Committee of the AB Shetty Memorial Institute of Dental Sciences (approval ID: ABSM/EC 71/2019).

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Consent to participate

Written informed consent was obtained from the participants.

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