

Assessment of Relationship between Chronic Periodontitis and Serum Vitamin D Status among Women during Pregnancy- A Case Control Study

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Abstract: Periodontal disease is one of the most common chronic infectious diseases, characterized by the loss of periodontal attachment leading to tooth loss. The prevalence of such disease in pregnancy ranges around 40%. Periodontal disease, as a source of persistent infection, may induce systemic inflammatory responses that increase the risk of adverse pregnancy outcomes. The aim of this study was to assess, compare and to correlate periodontal clinical parameters to the levels of vitamin D in Serum in pregnant women with plaque induced chronic periodontitis. The study included 49 otherwise systemically healthy pregnant women in their second trimester who were under prenatal vitamin D supplement (200 IU/day), with age ranging between 20-30 years. They were divided into four groups based on the severity of clinical attachment loss, Group I with healthy periodontal status, Group II with mild periodontitis, Group III with moderate periodontitis and Group IV with severe periodontitis. Biochemical assay of serum vitamin D was done using spectrometer. The levels of vitamin D in serum were significantly reduced in pregnant women with periodontitis group when compared to healthy controls. A statistical significant difference existed in mean the levels of vitamin D in serum of all groups studied with p-value < 0.001. Pearson correlation matrix test was applied to correlate the levels of vitamin D in serum and periodontal clinical parameters. The present study indicated that negative correlation was observed between all clinical parameters (mean plaque score and percentage of gingival bleeding sites, probing pocket depth and clinical attachment loss) and the levels of vitamin D and Serum vitamin D level deficiency has a negative influence on periodontal health in pregnancy.

Keywords: Vitamin D, pregnancy, adverse pregnancy outcomes, chronic periodontitis.

INTRODUCTION

Chronic periodontitis is a multifactorial infectious disease, characterized by the loss of periodontal attachment with a reported prevalence varying between 10%-60% in adults which might lead to tooth loss. Periodontal health is commonly affected in pregnancy. The prevalence of such disease in pregnancy ranges around 40%. Periodontitis, can cause pregnancy complications like low birth weight, preterm births, preterm low birth weight and pre-eclampsia [1].

During pregnancy, extra calcium required for fetal skeletal growth is attained by both maternal bone resorption and increased absorption from dietary sources, necessitating increased maternal vitamin D. When vitamin D levels are deficient, dietary calcium is not absorbed adequately. This deficiency disrupts phosphorus and calcium homeostasis, as well as bone mineralization.

Vitamin D has important immune-modulating properties, which may help to establish a proper maternal immune response to the placenta. Vitamin D has a direct role in preventing periodontal disease by killing bacteria through the production of antimicrobial peptides such as cathelicidin which reduces inflammation. It also reduces the concentrations of matrix metallo proteinases and maintains oral health [2].

Typical recommended dietary allowance for adults ranges from 200 to 600 IU depending on age. Though prenatal vitamin D supplement (200 IU/day), is usually given for pregnant women, the serum vitamin D status should be assessed as routine investigative procedure and dosage is increased for deficient patients. The aim of this study was to assess, compare and to correlate periodontal clinical parameters to the levels of

vitamin D in Serum in pregnant women with plaque induced chronic periodontitis.

MATERIALS AND METHODS

Study population

This case control study was conducted in the Department of obstetrics and gynecology Rajah Muthiah Medical College and Hospital, and Division of Periodontics, Rajah Muthiah Dental College and Hospital, Annamalai University. The study was approved by the Institutional Ethical Committee (Ref No:M18/RMMC/2013) and informed consent was obtained from study subjects. Study period was one year.

Patients with any systemic diseases., any form of periodontal treatment 6 months prior to the study, drugs and habits which interfere with the outcome of the study were excluded.

The study included 49 otherwise systemically healthy pregnant women in their second trimester of first pregnancy who were under prenatal vitamin D supplement (200 IU/day), with age ranging between 20-30 years. They were divided into four groups based on the severity of clinical attachment loss

Group I -15 pregnant women with healthy periodontal status.

Group II -10 pregnant women with mild periodontitis, with clinical attachment loss of 1-2 mm

Group III -12 pregnant women with moderate periodontitis with clinical attachment loss of 3-4 mm

Group IV -12 pregnant women with severe periodontitis with clinical attachment loss of more than or equal to 5 mm

Intra oral examinations were carried out utilizing a mouth mirror, a dental explorer and William’s periodontal probe. The periodontal parameters like Plaque index [15], gingival bleeding

index [13], probing pocket depth, clinical attachment loss [14] were recorded for those selected under study.

Estimation of Serum vitamin D level

Serum samples of 5ml were collected from antecubital fossa and 25 (OH) D assays was done using biochemical analysis with spectrometer. Serum 25(OH) D levels were stratified by Vitamin D guidelines [3] as

- Vitamin D deficiency, 25(OH)D < 50nmol/L(20ng/ml);
- Vitamin D insufficiency, 25(OH)D 51–74nmol/L(21–29ng/mol);
- Vitamin D sufficiency, 25(OH)D >75nmol/L(30ng/ml); and
- Vitamin D toxicity, 25(OH) D> 375nmol/L (150ng/mL).

STATISTICAL ANALYSIS

- All the data were analyzed using a software program (SPSS). Analysis of Variance (ANOVA) was applied to compare the mean values of the four groups.
- If ANOVA is significant Scheffe multiple comparison test was applied to compare periodontal parameters between the four groups.
- Pearson correlation coefficient test was applied to correlate biochemical parameter with periodontal clinical parameters.

RESULTS

The study included 49 otherwise systemically healthy pregnant women in their second trimester of first pregnancy who were under prenatal vitamin D supplement (200 IU/day), with age ranging between 20-30 years. The minimum and the maximum age of the subjects were 20 years and 28 years. In all the groups distribution of age and duration of vitamin D intake was similar and the difference was not statistically significant (p<0.165). A statistical significant difference existed in mean the levels of vitamin D in serum of all groups studied with p-value< 0.001(Table1).

Table-1: Mean and standard deviation of the levels of vitamin d in serum (nano moles per litre)

Groups	Mean	SD	Minimum	Maximum	ANOVA F- value	p-value
Group I Control(15)	92.751	11.458	67.9	113	31.83	< 0.001
Group II Mild(10)	91.2	11.970	76	109		
Group III Moderate(12)	65.873	8.951	45	75.7		
Group IV Severe(12)	58.588	10.896	46.5	87		

Pearson correlation matrix test was applied to correlate the levels of vitamin D in serum and periodontal clinical parameters.

A negative correlation was observed between all clinical parameters (mean plaque score and percentage of gingival bleeding sites, probing pocket depth and clinical attachment loss) and the levels of vitamin D in Serum (Table 2).

Table-2: Pearson correlation matrix test to correlate the levels of vitamin d in serum and periodontal clinical parameters

Periodontal Clinical parameters	Pearson correlation matrix	Matrix of Bonferroni Probabilities
Plaque score	0.410	0.014
Probing pocket depth	0.700	0.001
Percentage of Gingival bleeding sites	0.686	0.001
Clinical attachment loss	0.792	0.001

DISCUSSION

Vitamin D is a group of fat-soluble secosteroids and the major circulating metabolite of vitamin D is 25(OH) D. Assessment of levels of serum 25(OH) D is most useful in patients who are at risk of vitamin D deficiency.

Vitamin D is primarily responsible for regulating the intestinal calcium absorption. With inadequate vitamin D levels calcium and phosphorus homeostasis becomes impaired. The body then responds by increasing the production and release of parathyroid hormone into the circulation. The increase in parathyroid hormone restores calcium homeostasis by increasing renal tubular reabsorption of calcium in the kidney, increasing calcium mobilization from the bone, and enhancing the production of 1,25(OH)₂D[4].

Low intakes of vitamin D and calcium may lead to a negative calcium balance, thus causing a secondary release of calcium from bone, including the alveolar bone. In addition to its effect on skeletal homeostasis, vitamin D has anti-inflammatory and anti-microbial effects, via modulation of inflammatory cytokine production by immune cells and by stimulation of secretion of peptides with anti-bacterial action, by cells of the monocyte-macrophage lineage [5].

The inflammatory response leads to tissue destruction either by direct action of bacterial products, or by activation of host defense cells and secretion of inflammatory mediators. These locally produced factors eventually result in connective-tissue breakdown and bone loss via activation of osteoclast mediated bone resorption. Vitamin D reduces the risk of periodontal disease and gingivitis by the induction of LL-37 and defensins. Polymorphisms of the vitamin D receptor gene are also associated with periodontitis, alveolar bone loss, clinical attachment loss, and/or tooth loss [6].

Periodontal health is commonly affected in pregnancy. The prevalence of periodontal disease in pregnancy ranges around 40% despite the widespread use of prenatal vitamin D, because these are inadequate to maintain normal vitamin D levels (≥ 32 ng/mL).

The usual recommended doses range between 200–400 IU/day and suggested an increased recommendations which include 1000 IU/day, 5000 IU/week or a single dose of 200000 IU or more. The aim of the present study was to assess the periodontal status

clinically and to associate it to the levels of vitamin D in serum of pregnant women with or without periodontitis.

A total of 49 pregnant subjects in the age group ranging between 20 and 28 participated in the present study and were divided into four groups based on the severity of attachment loss namely pregnant women with healthy periodontal status and pregnant women with mild, moderate periodontitis and severe periodontitis.

The mean plaque score of the pregnant women in group four with severe periodontitis was significantly higher when compared to other groups ($P < 0.001$). The above results were in accordance with a cohort study by Garcia M *et al.* who studied one year effects of calcium and vitamin D supplements in chronic periodontitis patients and observed an increase in mean plaque score with increase in vitamin D deficiency status in otherwise healthy individuals ($P < 0.001$) [7].

The mean gingival scores of Group IV subjects were significantly higher as compared to group III and group III were significantly higher as compared to group I and II ($P < 0.001$). This is in accordance with single-center, randomized, double-blind, placebo-controlled parallel-group dose-ranging study done by Dietrich T, who observed a linear association between serum concentrations of 25-hydroxyvitamin D [25(OH)D] and gingival inflammation ($P < 0.001$) in non-smoking males and females and concluded that individuals with the highest 25(OH)D levels experienced 20% less bleeding on probing than those with the lowest levels, suggesting that vitamin D may reduce the risk of gingival inflammation by exerting anti-inflammatory effects and inhibitory effects on antigen induced T cell proliferation and cytokine production[8].

In the present study there was a statistically significant difference in the mean probing pocket depth and mean clinical attachment loss between subjects in group IV with severe periodontitis as compared to group III and subjects in group III were significantly higher when compared to group I and II (P value < 0.001). The above results were in contrast with the study by Dietrich T *et al.* who analyzed data on periodontal attachment loss (AL) and serum 25(OH)D concentrations and found an inverse association with attachment loss in men and women aged $>$ or $= 50$ years as assessed by

radioimmunoassay kit. In men and women younger than 50 years, there was no significant association between 25(OH) D and attachment loss [9].

Our present study was similar to a cross-sectional study by Bashutski J.D *et al.* who assessed the outcomes of periodontal surgery in subjects with normal level of vitamin D with deficiency subjects and found that vitamin D deficiency patients had significantly less clinical attachment gain (-0.43 mm vs. 0.92 mm, $p < 0.01$) and probing depth (PPD) reduction (0.43 mm vs. 1.83 mm, $p < 0.01$) than vitamin-D-sufficient individuals following periodontal surgery [10].

In the present study levels of vitamin D in serum was found to be least in group IV (severe periodontitis) followed by group III (moderate periodontitis), group II (moderate periodontitis), group I (control) ($p < 0.001$). The above findings are in accordance with Boggess KA *et al.* in studying maternal vitamin D status and periodontal diseases. They concluded that vitamin D insufficiency (serum 25[OH] D < 75 nmol/l) is associated with maternal periodontal disease during pregnancy [11].

Krall *et al.* in a 3-year randomized, placebo-controlled trial study, in assessing the effect of vitamin D in osteoporosis and tooth loss in elderly subjects concluded that supplements significantly reduced tooth loss in older persons over a 3-year treatment period with odds ratio 0.5 [12]. Whereas in our current study periodontal parameters were found to be inversely associated to levels of vitamin D in pregnant subjects during 2nd trimester

Few limitations that are associated with the present study are the small sample size, and lack of assessment of periodontal microbes and assessment of inflammatory cytokines.

Assessment of impact of scaling and root planning on serum levels of vitamin D during pregnancy should be carried out. Sensitive liquid chromatography - tandem mass spectrometry assay of 25(OH)D can also be used for vitamin D assay to improve the outcome of the study.

CONCLUSION

From the results of the current study the following conclusions were drawn:

The plaque score, gingival status, probing pocket depth and clinical attachment loss were higher in patients with chronic periodontitis when compared with healthy controls and were found to be statistically significant. The levels of vitamin D in serum were significantly reduced in pregnant women with mild, moderate and severe chronic periodontitis group when compared to healthy controls ($P < 0.005$) and were found to be the least in subjects with severe chronic periodontitis. A negative correlation was observed

between the levels of vitamin D in serum with periodontal parameters in all the groups.

From this study it could be concluded that the serum vitamin D deficiency could negatively affect periodontal health in pregnancy. Researchers have concluded that current recommended dosage is not sufficient and should be increased to improve maternal oral health. Future clinical trials with assessment of vitamin D intake from food and supplements should be investigated.

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