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Original Research Article

A Cross-Sectional Study of Serum Levels of Several Vitamins in Healthy and Unhealthy Periodontal Conditions

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Abstract: Vitamins are examples of micronutrients, which are nutrients needed in very minute quantities. They're crucial to metabolism and keeping tissues working properly. The purpose of this study was to determine whether vitamin deficiencies are associated with an increased risk of periodontitis. There was a total of 110 participants: 55 with chronic periodontitis spread throughout the mouth and 55 periodontally healthy individuals. Clinical parameters that were assessed included: Clinical attachment loss (in millimetres) and gingival index (in millimetres). Vitamin B12, vitamin D, folate, as well as vitamin E levels in serum samples were measured. Also measured were Beta-carotene and Beta-cryptoxanthin levels. The acquired data was aggregated and analysed using statistical programmes. All periodontal status clinical measures in the periodontitis group were statistically significantly different from those in the healthy volunteers group ($p < 0.0001$). Vitamin A precursors Beta-carotene and Beta-cryptoxanthin, folate, D, vitamins B12, and E, and vitamin E were all significantly lower in the periodontitis group compared to the healthy volunteers, but the difference was only statistically significant for vitamins B12 as well as D ($p < 0.05$). Finally, we conclude that serum micronutrient levels, particularly those of Vitamin A, Vitamin B12, and Vitamin D, may be modifiable risk factors for periodontal disease. In addition to practicing good dental hygiene on a regular basis, eating a diet rich in the right kinds of vitamins may play a significant part in warding off periodontitis.

Keywords: Vitamins, healthy, periodontitis, serum.

INTRODUCTION

Periodontitis is a commonly occurring inflammatory condition affecting the tissues that support the teeth. It is caused by specific microorganisms and leads to ongoing damage to the periodontal ligament and alveolar bone. The destruction of periodontal tissues is attributed to an exaggerated host immune-inflammatory response [1, 2]. According to estimates, periodontitis affects a significant portion of the global population, ranging from 40% to 90%. This prevalence positions periodontitis as one of the most pervasive epidemics on a global scale. There are several factors that have an impact on periodontal health. These include oral hygiene practises, environmental factors, genetic predisposition, overall systemic health, as well as nutritional choices [3]. For certain people, a lack of certain vitamins might play a role in the development and progression of periodontal disease [4].

The nutrients that obtained from the diet are vital for sustaining life. They serve as a crucial source of energy (macronutrients) and also act as cofactors for enzyme activity and contribute to the structure and function of various components (micronutrients) [5]. The reduction of any of these macro- or micronutrients can have detrimental effects on the health of the tissues that support the teeth [6]. Immunomodulatory and antioxidant micronutrients, as well as those involved in bone metabolism, may have an important role in periodontal disease prevention and therapy [7]. The micronutrients assessed in this study comprise Vitamin E, Folate, Vitamin B12, Vitamin D, as well as Vitamin A precursors.

Retinol, retinal 3-hydroxy retinol, as well as 3,4-dehydroretinol are all examples of the many forms of vitamin A. Moreover, it is worth noting that there exist more than fifty distinct varieties of carotenoids. These pigments, which are lipid-soluble, are abundant in plants and may serve as a source of vitamin A [8]. The most well-known of these chemicals are -carotene and -cryptoxanthin. Vitamin A's physiologically active form, retinoic acid, is essential for the proper functioning of mucosal tissues and the regulation of immune cell development [9]. Several epidemiological studies have investigated the correlation between vitamin A and periodontal disease. Numerous investigations have shown that low levels of vitamin A precursors in the blood are correlated with poor periodontal health [9, 10].

Cobalamin, commonly referred to as Vitamin B12, is involved in several essential biological processes, including collagen formation, metabolic functions, red blood cell synthesis, and nervous system development [11]. One research [12] found that those with low blood B12 levels were more likely to have clinical attachment loss, which may lead to tooth loss. Both folic acid and folate are forms of vitamin B9, although folic acid is synthetic whereas folate is found in nature. Folic acid insufficiency may cause a variety of oral symptoms, including widespread ulcerative glossitis, stomatitis, as well as cheilitis [13]. Given that folic acid promotes the growth of rapidly proliferating epithelial cells, a folic acid deficit may have consequences for the junctional epithelium. The rapid turnover rate of junctional epithelium plays a crucial role in both the cessation as well as prevention of progression the periodontal disease. There has been a previous association observed between folic acid insufficiency and chronic periodontitis in individuals who smoke [14].

Vitamin D, or cholecalciferol, comes in a few different forms; all of these work together to regulate calcium as well as phosphorus levels, which are essential for bone growth & metabolism. The impact of cholecalciferol in cell growth and neuromuscular function is also important [15] Furthermore, vitamin D has the potential to influence immune response and inflammation through its ability to cease the pro-inflammatory cytokines releasing and T-lymphocyte proliferation inhibition [16]. Vitamin D may help keep the bone and soft tissues around your teeth healthy, which might make it a useful tool in the fight against and treatment of periodontal disease. A correlation has been established between serum vitamin D3 levels and periodontitis, independent of bone mineral density. This finding highlights the importance of vitamin D's anti-inflammatory properties in relation to periodontal health [17].

Since alpha-tocopherol is the most common and physiologically active form of vitamin E, it is a great option for warding against vitamin E insufficiency in people. The polyunsaturated fatty acids in immune system cell membranes are protected from oxidation thanks to this essential lipid-soluble antioxidant [18]. Vitamin E's anti-inflammatory action on tissues is achieved through many ways. An anti-thrombotic effect is also seen [19]. Studies have showed conflicting results on the relationship between vitamin E and periodontal disease: some have discovered a negative link, while others have shown no significant correlation [20, 21].

The purpose of this research is to determine whether periodontitis risk is increased by a lack of six important micronutrients (Beta-carotene, Vitamin B12, Beta-cryptoxanthin, folate, Vitamin E as well as Vitamin D).

MATERIALS AND METHODS

One hundred and ten people participated in the research, including fifty five people with generalised periodontitis and fifty five people with healthy gums and teeth. The gender ratios of the groups were balanced. All of the volunteers had to be at least 20 years old, required to have at least 20 permanent teeth, were able to read and sign a permission form, and were in excellent general health, free of periodontal disease.

More than thirty percent of sites met both the pocket depth criterion (>5 mm) and the clinical attachment loss criteria (4 mm) for the diagnosis of generalised periodontitis. The gingival index at rest was less than one at fewer than 30% of the sites in the healthy participants. Researchers could not include those who met the following criteria: had diabetes; were pregnant or nursing; had taken an antibiotic within the previous 3 months; had taken a vitamin or health supplement within the previous 6 months; or were current smokers.

Serum samples were taken from patients first thing in the morning and stored in standard vacutainers. The blood concentrations of several vitamins were then determined after the samples were forwarded to the medical laboratory. The concentrations of Beta-cryptoxanthin, Beta-carotene, as well as vitamin E were measured using HPLC, while those of vitamin B12 and folate were measured using ELISA. LC-MS/MS was used to determine vitamin D concentrations.

Means and standard deviations (SD) for clinical measures such as probing depth, gingival index, as well as CAL were determined for all participants and groups. Mean and standard deviation were also calculated for micronutrient concentrations in the serum. For making comparisons between groups, we used Student's t-test for independent means. A p-value less than 0.05 was considered statistically significant throughout data compilation and analysis.

RESULTS

Table 1 summarizes all clinically-obtained data, including pocket depth, gingival index, as well as CAL. The average ages of the two groups did not differ statistically significantly (p = 0.084). When comparing the unhealthy periodontitis group to the normal healthy volunteers, all other clinical indicators used to assess periodontal health showed statistically significant differences (p < 0.0001).

Table 1: Clinical Parameters of People with Healthy Gums and People with Generalised Periodontitis Compared

	Healthy Volunteers (N = 55)	Generalized Periodontitis (N = 55)	p-value
Age (years)	31.82±1.3	32.45±2.93	0.084
Mean GI	0.58±0.1	1.92±0.36	<0.001a
Mean PPD (mm)	1.51±0.8	4.21±1.2	<0.001a
Mean CAL (mm)	0	4.57±1.03	<0.001a

[a]p value <0.05 (significant).

Vitamins B12, folate, D, and E, as well as the antioxidant vitamins Cis--carotene and -cryptoxanthin, were measured in the blood of people with Periodontitis and healthy volunteers. Table 2 summarises the findings. The periodontitis group had lower mean levels of all the micronutrients, including vitamin A precursors Beta-carotene and Beta-cryptoxanthin, folate, vitamin B12, vitamins E & D, but the difference was only significant for vitamin B12, β-cryptoxanthin, as well as vitamin D (p < 0.05).

Table 2: Vitamin levels in the serum of healthy participants compared to those of those with chronic periodontitis

	Healthy Volunteers (N = 55)	Generalized Periodontitis (N = 55)	p-value
Vitamin D (nmol/l)	41.3±2.71	33.57±4.8	0.0017[a]
Vitamin E (mg/dl)	711.6±19.4	698±42.13	0.46
Folate (ng/ml)	13.19±1.32	13.54±4.91	0.18
Vitamin B 12 (pg/ml)	291.4±21	254.8±36.7	0.0381[a]
β-Cryptoxanthin (mg/dl)	13.64±1.3	10.18±3.2	0.023[a]
β-carotene (mg/dl)	14.59±0.82	13.95±2.61	0.761

[a]p value <0.05 (significant).

DISCUSSION

Micronutrient malnutrition occurs when the body does not get enough of, or has insufficient access to, the vitamins and minerals necessary for proper functioning and the upkeep of its structural molecules. Lifestyle choices, medicine use (including antacids, diuretics, antibiotics, laxatives, etc.), systemic illness, malabsorption, and diarrhoea are only some of the causes of this deficit [23]. Age, gender, physiological condition, as well as disease processes all have a role in the body's ability to make use of certain micronutrients [24].

Micronutrients' role in periodontitis' onset and progression has been the subject of several research studies [25]. The potential significance of micronutrients in the treatment of periodontal disease has been investigated as an adjunct to conventional medical treatments. The aim of this study was to address this knowledge gap by testing the hypothesis that vitamin deficiency is a variable risk factor for the onset of the chronic periodontitis in many population. The most noteworthy discovery made by the researchers was the probable link between vitamin levels in the blood and the onset of periodontal disease.

Carrots, mangoes, and other orange and yellow vegetables and fruits are excellent plant-based sources of the pro-vitamin A carotenoids ß-carotene and ß-cryptoxanthin. Enzymes convert these carotenoids into retinol, making them an excellent source of vitamin A and protecting against a deficit [26]. Epidemiological studies have shown that when Vitamin A levels in the blood rise, the risk of periodontitis decreases and vice versa [27]. Dodington *et al.,* found that patients who increased their intake of dietary -carotene following non-surgical periodontal treatment had a decreased prevalence of locations with pocket depths more than 3 mm. The drop in pocket depth was also greater among ex-smokers than in smokers [28]. The incidence of severe periodontitis with a high threshold was also associated with beta-carotene and beta-cryptoxanthin, according to another research. In a study of middle-aged Western European males, researchers found that lower levels of many carotenoids in blood, notably beta-carotene and beta-cryptoxanthin, were linked to an increased risk of periodontitis [10]. We found that there was a negative connection between beta-cryptoxanthin and periodontitis, but not with the other carotenoid levels.

Water-soluble vitamin B12 and folate are essential for a number of bodily functions, including synthesis of collagen as well as creation RBCs. Vitamin B12 helps in DNA synthesis, and folic acid is principle for the cell division

[11, 13]. The loss of periodontal attachment, and hence teeth, has been linked in recent studies to low levels of vitamin B 12 in the blood [12]. Another study used health, smoking, periodontitis, as well as gutkha chewing to divide 111 persons of varying ages into four categories. clinical attachment level, Pocket probing depth, as well as gingival index were only some of the numerous clinical markers assessed in addition to vitamin B12 and folate levels. People with chronic periodontitis who smoked gutkha had greater amounts of vitamin B12 in their blood than those with periodontitis or who were healthy. The levels of folate in smokers with periodontitis were lower than those in non-smokers [29]. Our data showed that chronic periodontitis patients had considerably lower amounts of vitamin B12 than healthy individuals. folic acid levels in blood did not vary significantly between individuals with periodontitis and those without the condition.

Higher vitamin D blood levels have been linked in many studies to a decreased risk of tooth loss due to periodontitis [17, 30]. Predicted levels of 25-hydroxyvitamin D were shown to have a strong negative connection with tooth loss in one study. A decreased incidence of tooth loss is associated with greater levels of 25-hydroxyvitamin D. Additionally, there was a lowered incidence of tooth loss among those who were exposed to UV-B. Vitamin D risk factors were shown to be inversely related to the occurrence of tooth decay and periodontitis [30]. Our data showed that both the control and periodontitis groups had vitamin D levels that were considerably lower than the healthy group. Previous research that have shown comparable results corroborate these new ones [31, 32]. One study looked at how postmenopausal women's plasma 25-hydroxyvitamin D levels correlated with their risk of developing periodontal disease. Researchers observed that women whose vitamin D levels were acceptable had a 33% reduced risk of periodontal disease and a 42% lower risk of having at least 50% of their gingiva bleed compared to women whose vitamin D levels were inadequate [31]. Bone mineral density is inversely proportional to vitamin D blood levels, suggesting that vitamin D plays an important role in bone metabolism. Bone-forming minerals calcium and phosphorus are poorly absorbed from the intestines when vitamin D levels are low. It is also accountable for the increased innate immune activity of epithelial cells and the release of antimicrobial peptides. It inhibits both monocyte and macrophage cytokine production and NF-B activation [16]. The relationship between vitamin D and periodontal disease may change in another manner as a result of this.

Vitamin E, an antioxidant, has a role in suppressing ROS production via interacting with cell membranes and fat tissues [18]. The Vitamin E levels of the two groups were not significantly different. There is a lack of data on the effectiveness of vitamin E in treating periodontitis. The association between periodontal health and blood tocopherol levels was investigated using data from the NHANES, which included 4708 people. Serum tocopherols were assessed by high-performance liquid chromatography (HPLC), and results were normalised to total cholesterol (TC). Serum Alpha-tocopherol: TC quartiles were inversely linked with mean probing pocket depth, mean clinical attachment loss, as well as overall periodontitis [33]. Vitamin E appears to hasten the recovery of periodontal tissues when taken as a supplement [34]. In addition, periodontitis patients whose dietary intake of -tocopherol, other antioxidants, and omega-3 fatty acids were increased saw a reduction in their periodontal pocket depth, however this beneficial effect was confined to those who did not smoke [28].

CONCLUSION

Our findings suggest that dietary vitamin intake and blood levels of certain vitamins, such as vitamins A, B12, and D, may be variable risk factors for occurrence of the periodontal disease. The disease may be avoided by maintaining a healthy diet with a balanced intake of micronutrients and by regularly cleaning and inspecting the teeth and gums.

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