

## ORIGINAL RESEARCH

# Does Hypertension have Association with Periodontitis? A Cross-sectional Study

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## ABSTRACT

**Introduction:** Periodontitis and cardiovascular diseases have an established interlink in the present decade. Several potential mechanisms of hypertension-induced periodontal deterioration have been proposed. Therefore, the present study is to find out an association between periodontitis and hypertension.

**Materials and methods:** The study design consists of patients who were diagnosed for chronic periodontitis in Department of Periodontology and Implantology of Institute of Dental Sciences, Bareilly, Uttar Pradesh, India for a duration of 6 months. The participants include both male and female patients with an age group of 30 to 59 years. Care was taken in evaluating patients with any other systemic disease. Their blood pressure was assessed at a different interval of time to obtain the average values. The data was assessed for the suitable statistical analysis using the Statistical Package for the Social Science, version 22.0 to establish if there is any possible association with hypertension and periodontitis.

**Results:** Hypertension showed a nonsignificant correlation with periodontitis patients in the age group of 30 to 59 years, independent of known confounders. A negative association was found between periodontitis and hypertension by using Spearman's correlation coefficient test.

**Conclusion:** The results of the present study do not suggest that clinically detectable signs of infectious periodontal disease, gingival bleeding, and periodontal pocket formation are related to hypertension, individuals aged 30 to 59 years.

**Keywords:** Body mass index, Diastolic blood pressure, Hypertension, Periodontitis, Pocket depth, Systolic blood pressure.

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## INTRODUCTION

Periodontitis is a chronic infectious disease of the supporting tissues of the teeth, with multiple related factors.

In recent years, interest has grown regarding the relationship with other systemic conditions to identify some new aspects to improve diagnostic tools and treatment outcomes.<sup>1</sup> Hypertension, defined as blood pressure values above 140/90 mm Hg, is a known risk factor for atherosclerotic vascular diseases, and medication is recommended by the American Heart Association when blood pressure values exceed 140/90 mm Hg.<sup>2,3</sup> Hypertension is a common disease, and from the public health point of view, it is important to study whether infection in the periodontium plays a role in its development.<sup>3</sup>

Periodontal disease has drawn increasing attention for its association with cardiovascular disease (CVD), as a chronic multifactorial condition linked with systemic inflammatory markers and endothelial dysfunction; known as a major risk factor for CVD, hypertension is also considered to a role as a risk factor for periodontitis. World Health Organization (WHO) reported that periodontitis and hypertension affect approximately one-third of the world's adult population.<sup>4</sup>

A possible pathogenetic mechanism connecting periodontitis with elevated blood pressure has been suggested to include the systemic inflammatory burden related to local inflammation, the direct microbial effect on the vascular system, and subsequent alterations in endothelial function.<sup>2,4,5</sup> Several potential mechanisms of hypertension induced periodontal deterioration have been proposed. Endothelial dysfunction of small arteriolar wall thickening and microcirculatory dysfunction caused by high blood pressure have been suggested as possible mechanisms.<sup>2,4</sup> Due to the lack of evidence on the association of hypertension with periodontitis, this study objective was to test the hypothesis that hypertension is associated with periodontitis.

## MATERIALS AND METHODS

### Study Design and Subjects

Subjects were diagnosed as chronic periodontitis of age group 30 to 59 years, on a duration of 6 months were selected from the outpatient Department of Periodontology and Implantology of Institute of Dental Sciences, Bareilly. After obtaining written consents from patients, cross-sectional analyses were performed. Out of the 310 participants of this survey, only those individuals

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aged between 30 and 59 years who had complete datasets were included in the analysis, which constituted a total of 200 participants (123 males and 77 females). These patients were then divided into three groups: Normotensive patients [systolic blood pressure (SBP) < 120 mm Hg and diastolic blood pressure (DBP) < 80 mm Hg] – group I; prehypertension patients (120 < SBP < 140 mm Hg or 80 < DBP < 90 mm Hg) – group II; and hypertension patients (SBP ≥ 140 mm Hg or DBP ≥ 90 mm Hg or taking antihypertensive medication) – group III.<sup>4</sup>

### Assessment of Hypertension

A standard mercury sphygmomanometer (Baumanometer, WA Baum, Copiague, New York, USA) was used to measure SBP and DBP on the participant's right arm in a seated position after at least 5 minutes of rest before the initial measurement. The blood pressure measurements were taken twice at a 5-minute interval, and the average values were used for the analysis. For our analysis, prehypertension was defined as having either 120 < SBP < 140 mm Hg or 80 < DBP < 90 mm Hg and hypertension was defined as having an average SBP over 140 mm Hg or DBP over 90 mm Hg or medicated for hypertension. This classification was based on the SBP and DBP cut-off points suggested by the seventh report of the Joint National Committee (JNC7) report.<sup>6</sup>

### Assessment of Periodontitis

Periodontal status of the participants was assessed by dentists by measuring the periodontal pocket depth (PD) (of more than 5 mm), a University of North Carolina 15 probe was used. Periodontal PD were measured at six sites (mesiobuccal, midbuccal, distobuccal, distolingual, midlingual, and mesiolingual) per tooth. Ten index teeth selected for the examination were: The first and second molars in each posterior sextant, the upper right incisor in upper middle sextant, and the lower left central incisor in lower middle sextant.<sup>4</sup> If the index tooth was absent in a sextant, the adjacent tooth was examined. If no adjacent tooth was present, all remaining teeth were examined and the highest score was recorded as the score for that sextant.<sup>4</sup> For the analysis, periodontal status was dichotomized into periodontitis negative (PD < 5 mm) and periodontitis positive (PD > 5 mm).

Gingival bleeding was used as a complementary explanatory variable. It was measured by bleeding on probing, which was registered immediately after PD measurements in each sextant. The observations were categorized as follows: No bleeding on probing, bleeding on probing in one or two sextants, and bleeding on probing in three or more sextants.<sup>2</sup>

### Assessment of Potential Confounders

The following variables were considered as potential confounders: (1) Age, (2) sex, (3) smoking, (4) obesity, (5) drinking, (6) hypercholesterolemia, and (7) diabetes mellitus.

Information on age, sex, and lifestyle variables, such as smoking and drinking habits, was collected from the patients. Participants were categorized into three groups: 30 to 39, 40 to 49, and 50 to 59 years. Self-reported smoking status was similarly dichotomized into never smokers or ever a smoker in lifetime. Self-reported alcohol consumption was dichotomized into none or ever in lifetime. Body weight and height were measured to the nearest 0.1 kg and 0.1 cm respectively, with the participants in light in-door clothing without shoes. Body mass index (BMI) was calculated using the formula weight/height<sup>2</sup> (kg/m<sup>2</sup>). Obesity was defined as having BMI over 25 kg/m<sup>2</sup>.<sup>4</sup> Blood samples were collected from the antecubital vein of each participant after at least 8 hours of fasting and analyzed within 24 hours of collection. Concentration of total cholesterol (TC) and fasting plasma glucose (FPG) were measured in an automatic analyzer using commercially available enzymatic assay kits. Hypercholesterolemia was defined as having TC over 240 mg/dL or medicated for hypercholesterolemia.<sup>4</sup> Diabetes was defined as FPG over 126 mg/dL or medicated for diabetes, according to the WHO criteria (WHO, 2006).<sup>1</sup>

### Statistical Analysis

In the analysis, the outcome variable was periodontitis and the main explanatory variable was hypertension status. Summary statistics of the population characteristics were calculated as frequencies and percentages. Any statistically significant differences between the periodontitis positive and negative groups, in terms of the behavioral and health-related factors, were examined using chi-square test.

Statistical analysis of the data was done using the Statistical Package for the Social Sciences, version 22.0. The data was compiled using Microsoft excel sheet (Windows 2007). For each variable the mean and standard deviation were calculated. One-way ANOVA was performed for multiple comparisons followed by Tukey's *post hoc* test for pairwise comparisons. Chi-square test was performed to find association between groups.  $p < 0.05$  is considered statistically significant.<sup>7</sup> Association between periodontitis and hypertension was assessed by using Spearman's correlation coefficient test.

### RESULTS

The results regarding hypertension as the outcome are presented in Tables 1 and 2. Hypertension showed a

Does Hypertension have Association with Periodontitis? A Cross-sectional Study

**Table 1:** Intragroup comparison of pocket depth in groups I, II, and III

Groups	Pocket depth			
	Mean±SD	Mean±SD	t-value	p-value
I and II	3.83±0.5	3.71±0.49	0.655	0.5141 NS
I and III	3.83±0.5	3.61±0.42	1.1976	0.2415 NS
II and III	3.71±0.49	3.61±0.42	0.8469	0.3993 NS

NS: Nonsignificant; SD: Standard deviation

**Table 2:** Intragroup comparison of plaque index in groups I, II, and III

Groups	Plaque index			
	Mean±SD	Mean±SD	t-value	p-value
I and II	1.48±0.74	1.52±0.6	0.1747	0.8618 NS
I and III	3.83±0.5	1.49±0.86	0.0290	0.9771 NS
II and III	1.52±0.6	1.49±0.86	0.1812	0.8566 NS

NS: Nonsignificant; SD: Standard deviation

nonsignificant correlation with periodontitis patients in the age group of 30 to 59 years, independent of known confounders.

Pocket depth was measured for all patients in all the three groups. Results showed the mean PD in group I patients was 3.83±0.5; in group II patients was 3.71±0.49, and in group III patients was 3.61±0.42

Plaque index of patients were also taken to study its relation with hypertension. The mean plaque index was 1.48±0.74 in patients of group I; 1.52±0.6 in patients of group II; and 1.49±0.86 in patients of group III.

The intragroup comparison was done for PD and plaque index in groups I, II, and III. This reveals a non-significant co-relation of patient's mean PD and plaque index with the hypertension shown in Table 3.

The intragroup comparison of patient's age and gender in groups I, II, and III was also performed and the analysis showed its negative co-relation with hypertension.

We also studied whether gingival bleeding was related to hypertension. The analyses showed a negative association between gingival bleeding and hypertension; no essential association was found after adjusting for the above-mentioned confounding factors.

**DISCUSSION**

This cross-sectional study showed that there was no consistent association between periodontitis with deepened periodontal pockets or the number of bleeding sextants and hypertension, indicating that either

**Table 3:** Correlation of (pocket depth, plaque index, and bleeding index) periodontitis between prehypertension and hypertension

	r-value	p-value
<i>Pocket depth</i>		
Pearson's R	0.017	0.940 NS
Spearman correlation	-0.101	0.662 NS
<i>Plaque index</i>		
Pearson's R	0.061	0.794 NS
Spearman correlation	0.106	0.648 NS
<i>Bleeding index</i>		
Pearson's R	-0.307	0.176 NS
Spearman correlation	-0.307	0.176 NS

NS: Nonsignificant

there is no true relation between periodontal condition and blood pressure or this association is too weak to be detected in this kind of nonexperimental setting. By showing practically no association between periodontal condition and hypertension, the findings of our study concur to a previous cohort study among health professionals reporting no significant association between self-reported periodontal disease or tooth loss and hypertension.<sup>8</sup> The findings of our study are in contradiction with an earlier case-control study, where an association between the extent of gingival bleeding, tooth loss, and the number of sites with a PD of 4 mm or more and SBP and DBP was reported,<sup>9</sup> and also with a cross-sectional study where severe periodontitis was found to be associated with high SBP.<sup>10</sup>

In this study, we controlled for potential confounding factors in several ways. Restrictions on the data produced a fairly homogenous population consisting of dentate, nonsmoking individuals who were 30 to 59 years of age. Diabetic subjects as well as those with any indication of diabetes were excluded from the study to avoid the confounding effect of diabetes. Age restriction was used to reduce the confounding effect of age and age-related factors, such as attitudinal factors, financial resources, as well as extraction-oriented treatment modalities in the past. To exclude the possible effect of the number of remaining teeth, we used also proportional measures of periodontally affected teeth. These analyses did not show any positive association between periodontal pocketing and hypertension. In addition, as in standard practice in any observational nonexperimental study, we adjusted for many competing risks or other determinants of hypertension, such as age, gender, BMI, physical activity, and serum lipid composition (triglycerides, HDL-C, LDL-C) by using multivariate models. It is possible that these above-mentioned restrictions (age, diabetes, smoking history) and the thorough control of confounding factors is the reason why the results of this study differ from those of many earlier studies.<sup>2</sup> Naturally, this study has its limitations. One of them is the cross-sectional study design, which prevents determination of the temporal sequence between exposure and outcome. Moreover, a more important limitation is the sample size.

We also performed analyses among men and women separately (including smokers) and among all age groups (including smokers). The results of these analyses did not show any consistent association between the extent of periodontal infection and hypertension. Perhaps the most important implication of this study is that the association between periodontal condition and hypertension seems to be confounded. This confounding is most likely related to a number of different behavioral or biological risks in common. In addition, it is possible that periodontitis and hypertension may have other determinants in common, possibly related to increased susceptibility to inflammatory or infectious diseases.

## CONCLUSION

The results of the present study do not suggest that clinically detectable signs of infectious periodontal disease, gingival bleeding, and periodontal pocketing are related to hypertension or SBP in nondiabetic, nonsmoking individuals.

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