

When Periodontitis is met with a Cardiovascular Risk: A Cross-Sectional Study

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Abstract:-

Introduction: An increasing attention has been drawn for a periodontal disease and its correlation with cardiovascular disease (CVD), which can be referred as a chronic multifactorial condition associated with systemic inflammatory markers and endothelial dysfunction. Therefore, a thoroughly designed prospective and interventional trials are needed in order to determine whether there is an independent relationship between periodontitis and various CVD risk factors.

Aim and Objectives:

To evaluate the relationship of hypertension and high systolic and diastolic blood pressure with periodontitis in hypertensive patients.

Materials and Method: A standardized questionnaire based cross-sectional study involving 105 subjects (age between 40-80 years) with systemic arterial hypertension using interviews and oral examinations to collect data on sociodemographic characteristics (age, sex, household income), smoking, periodontal status (bleeding on probing, and attachment loss), drinking, smoking, physical activity, obesity, hypercholesterolaemia and diabetes mellitus. Clinical parameters like pocket depth were measured for assessing periodontal status.

Results and Conclusion: A significant positive causal association was seen between hypertension and periodontitis. Hence, it was concluded that hypertension was associated with chronic periodontitis and higher risk for having both SBP and DBP independent of known confounders in hypertensive patients.

Keywords:- Hypertension, Periodontitis, Hypercholesterolaemia.

I. INTRODUCTION

Periodontitis is characterized by clinical attachment loss and adjacent supporting bone loss. It is estimated that 5–20% of adults suffer from severe generalized periodontitis.^[1] If left untreated, it can lead to deterioration of the periodontium and eventually to tooth loss.^[2]

Periodontitis is induced by dental plaque and known factors contributing to disease progression include: age, oral hygiene, smoking, alcohol consumption, depression, socioeconomic status, genetics, psychosocial stress, gender, obesity and wide array of systemic diseases. Taking together, it seems that periodontitis is not merely a consequence of plaque accretion but significant contribution of host factors is also there.^[1]

About 30% of adults are highly affected with greatest prevalence of systemic arterial hypertension. It is associated with cardiovascular disease and mortality in a log-linear relationship such that starting at 115 mm Hg systolic blood pressure until 180 mm Hg, each 20 mmHg of blood pressure is associated with approximately 2 fold increase in risk of death from heart disease, stroke, or other vascular disease.^[3] Such kind of causal relationship has been postulated to be both indirect, i.e. via shared risk factors, and direct through adverse systemic ramifications including an inflammatory generalization.^[2]

Since periodontal and heart diseases share common risk factors and both predicting health-related psychosocial outcomes, their effects are shown to be cumulative in nature.^[4] It has been elucidated that periodontal disease and/or tooth loss are positively associated with blood pressure levels and hypertension as suggested by several cross-sectional epidemiologic studies.

A growing body of evidence advocates a role of inflammation and the immune system in the dysregulation of controlled blood pressure developing hypertension.^[3] As, both hypertension and periodontitis are regarded as a major health problems, elucidation of their association is of utmost importance.

Various processes of periodontal destruction carried out by hypertension have implicated.^[5] It has been suggested that bacteria and their byproducts present in microbial plaque and crevicular fluid results in the stimulation of immune cells thus leading to the production and release of certain inflammatory mediators. They also play a major role in the destruction of gingiva and bone, and their serum concentration is regarded as a marker of periodontal disease.^[6] Patients suffering from periodontal diseases are

more susceptible to bacterial endotoxins, thereby leading to systemic inflammation through an increase in proinflammatory cytokines.^[7] and are usually the predictors of cardiovascular morbidity and mortality.^[6]

According to **Ross and Glomset's** theory, development of atherosclerosis results from excessive production of reactive oxygen species, endothelial dysfunction, and low-density lipoprotein is only mediated by an inflammatory mechanism and inflammation is responsible for the main root cause behind it.^[7] Thus, depicting inflammatory processes and endothelial related vasoactive mediators as a key consolidating contributors in the bidirectional relationship between hypertension and periodontitis.^[2]

Periodontal disease commonly surrogates tooth loss leading to complete edentulism. Thus, periodontal disease can be prevented as treatment of periodontitis results in the improvement in inflammatory cytokine profile.^[3]

Therefore, considering high prevalence and insufficient awareness of causal and bidirectional relationship between periodontitis and hypertension, a cross-sectional study was undergone, in order to provide evidence demonstrating the relationship between the two diseases.

II. MATERIALS AND METHODS

Study design and subjects

A questionnaire based study involving 105 subjects (52 men, 53 women, mean age between 40-80 years) with systemic arterial hypertension was conducted in the Department of Periodontology, Sri Guru Ram Das Institute of Dental Sciences and Research, Amritsar using interviews and oral examinations to collect data on sociodemographic characteristics viz. age, sex, income, alcohol consumption, smoking, physical activity, obesity, hypercholesterolaemia, diabetes mellitus (DM), Hypertension, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were measured. Participants with insufficient data were excluded from the study.

Assessment of hypertension

SBP and DBP were measured using a standard mercury sphygmomanometer twice and the measurements were derived.

Assessment of periodontitis

With the use of Community Periodontal Index of Treatment Needs (CPITN), periodontal status of the participants was assessed. Periodontal pocket depths (PD) were measured at 6 sites per tooth.

Assessment of potential confounders

Information regarding the confounders were collected from the participant's through a standardized questionnaire as given in [Table 1]

III. STATISTICAL ANALYSIS

In the analysis, hypertension status was the main explanatory variable and periodontitis was the outcome variable. Analysis was done using Pearson chi-square test. For the analyses, statistical significance was set at $p\text{-value} < 0.05$

IV. RESULTS

Our study was conducted to evaluate the relationship of hypertension and high systolic and diastolic blood pressure (SBP and DBP) with periodontitis in hypertensive subjects. The novelty of this type of study is the examination of variety of permutations of potential confounders.

Among the sample population, when evaluating the potential cofounders. There was a statistically significant correlation with periodontitis independent of the other confounders evaluated. [FIG. 1 & 2] The prevalence of periodontitis was seen mainly in females, older, predominantly smokers, presenting with lower income, with increased prevalence of DM and hypertension in hypertensive patients. [TABLE 2]

V. DISCUSSION

Periodontitis is regarded as a potential inflammatory disease involving the periodontium. Infection or tissue injuries caused by periodontitis results in the increase in the levels of various inflammatory cytokines thereby leading to systemic inflammation. Therefore, the interrelationship between periodontitis and CVD may be associated with chronic inflammation via pathways of coronary atherosclerosis and thromboembolism. However, the association can be influenced by some of the confounders depicted in [Table 1]^[7]

Our results demonstrated a positive association with periodontitis independent of the other risk factors among hypertensive patients.

With the valuable insights, our study depicts the evidence that there is an intricate association of hypertension with high prevalence of periodontitis in older age group and more in females as compared to males. This study unearths the importance of female sex in the relationship between hypertension and periodontitis as females share higher risk of developing CVD. **Appelman et al. (2015)**^[8] the plausible explanation dictates that females tend to have lower threshold blood pressure for developing peripheral vascular diseases, due to the higher prevalence of arterial stiffness seen specifically in females. **Coutinho (2014)**^[9]

In the present study, highest income group (above poverty level) illustrated less common risk factors, than people with below poverty level. This could be attributed to the fact that people below low poverty level have poor oral hygiene, inadequate diet and neglect health facilities much often. **Tsioufis et al. (2011)**^[2]

Also, age and smoking, are well-recognized risk factors for periodontitis. In congruence with our findings, **Machado V et al. (2020)**^[10] reported that patients with periodontitis older than 45 years of age were considered to be 2.31 times more likely to encounter metabolic disorders like diabetes mellitus and CVS.^[1]

Indeed, smoking is strongly associated with periodontitis as it exerts its effect by concomitantly affecting neutrophil function, leading to shift in a more pathogenic microflora, resulting in sustained peripheral vasoconstriction. Smokers are a way more prone to plaque accumulation with increased signs of gingivitis, considerably sharing a higher risk of teeth loss.^[1]

In the present study, there was a positive association with periodontitis independent of the confounders being evaluated. Alcohol intake, non-exercise, obesity and diabetes are eminent confounders having relationship between hypertension and periodontitis.^[2] **Aoyama N et al. (2018), Gopalamy K et al. (2020)**

Therefore, treating severe periodontitis has been proven to reduce systemic inflammation levels by improving

endothelial function. The results provided by our investigation depicted some momentous strength's, but also limitations too. One of the stupendous results in our study included the dental examination with detailed full-mouth protocol so as to increase the sensitivity, and a comprehensive analysis plan. Further longitudinal studies are needed to mount the nature of the association between periodontitis and BP, including inflammatory markers in order to alleviate complications of CVS in the long run.

VI. CONCLUSION

Our data instigated that the patients with periodontitis, particularly those with higher levels of periodontal pockets, have the higher risk for having both SBP and DBP. Moreover, age, sex, income, alcohol consumption, smoking habits, physical activity, obesity, hypercholesterolaemia and diabetes mellitus were independently associated with raised blood pressure. These results indicate that periodontitis may have an important negative impact on blood pressure. Thus an appropriate approach towards management of risk factors related to CVD must be performed in the future.

TABLES:

TABLE 1: QUESTIONNAIRE

<u>VARIABLE</u>	<u>PERIODONTITIS</u>	
	YES	NO
1. AGE (YEARS):		
✓ 40		
✓ 41-50		
✓ 51-60		
✓ 61-70		
✓ 80		
2. SEX:		
✓ Male		
✓ Female		
3. HOUSEHOLD INCOME:		
✓ Below Poverty Line		
✓ Above Poverty Line		
4. ALCOHOL INTAKE:		
✓ Abstinence		
✓ Moderate intake		
✓ Heavy intake		
5. SMOKING:		
✓ Non-smoking habit		
✓ Ex-smoking habit		
✓ Current smoking habit		
6. PHYSICAL ACTIVITY:		
✓ None		
✓ ≥1 day/week		
7. OBESITY:		
✓ Non-obese		
✓ Obese		
8. HYPERCHOLESTROLAEMIA:		
✓ No		
✓ Yes		
9. DIABETES:		
✓ Non-diabetic		

- ✓ Diabetic
- 10. HYPERTENSION:**
- ✓ Normal
- ✓ Pre-hypertension
- ✓ Hypertension
- 11. SYSTOLIC BLOOD PRESSURE:**
- ✓ <120 mm Hg
- ✓ 120 ≤ SBP < 140 mmHg
- ✓ ≥140 mm Hg
- 12. DIASYSTOLIC BLOOD PRESSURE:**
- ✓ <80 mm Hg
- ✓ 80 ≤ DBP < 90 mm Hg
- ✓ ≥90 mm Hg
- ❖ Household income: According to indian concensus, income less than Rs 78,000 per year was considered below poverty line.
- ❖ Physical activity (was assessed by the number of days per week strenuous activities are conducted)
- ❖ Obesity (Assessed through body mass index (BMI, kg/m²) ≥ 25)
- ❖ Hypercholesterolaemia: total cholesterol in blood (TC) ≥ 240 mg/dl or medicated for hypercholesterolaemia; normal: TC < 240 mg/dl)
- ❖ Diabetes mellitus (Fasting plasma glucose (FPG) ≥ 126 mg/dl or medicated for diabetes; pre-diabetes: 100 ≤ FPG < 126 mg/dl; normal: FPG < 100 mg/dl)
- ❖ Hypertension (Hypertension: SBP ≥ 140 mmHg or DBP ≥ 90 mmHg or medicated for hypertension; pre-hypertension: 120 ≤ SBP < 140 mmHg or 80 ≤ DBP < 90 mmHg; normal: SBP < 120 mmHg and DBP < 80 mmHg)

TABLE 2: RELATIONSHIP BETWEEN PERIODONTITIS & SOCIO-ECONOMIC FACTORS, DIABETES MELLITUS, SBP & DBP

		Periodontitis				P value
		No		Yes		
		N	%	N	%	
Age (years)	≤40	1	8.3	11	91.7	0.316; NS
	41-50	4	12.1	29	87.9	
	51-60	1	2.9	33	97.1	
	61-70	-	-	20	100.0	
	>70	-	-	6	100.0	
Sex	F	2	3.8	51	96.2	0.387; NS
	M	4	7.7	48	92.3	
Income	APL	4	13.8	25	86.2	0.028*
	BPL	2	2.6	74	97.4	
Drinking	Frequent	2	8.3	22	91.7	0.760; NS
	Occasional	1	7.1	13	92.9	
	Never	3	4.5	64	95.5	
Smoking	Frequent	2	9.1	20	90.9	0.717; NS
	Occasional	1	6.3	15	93.8	
	Never	3	4.5	64	95.5	
Physical activity	None	1	1.7	58	98.3	0.044*
	Yes	5	10.9	41	89.1	
Obesity	Non- Obese	5	13.9	31	86.1	0.009*
	Obese	1	1.4	68	98.6	
Hypercholesterolaemia	No	5	14.7	29	85.3	0.006*
	Yes	1	1.4	70	98.6	
Diabetes	Non-Diabetic	6	9.7	56	90.3	0.036*
	Diabetic	-	-	43	100.0	
Hypertension	Normal	1	8.3	11	91.7	0.003*
	Pre- Hypertension	4	22.2	14	77.8	
	Hypertension	1	1.3	74	98.7	
Systolic Blood Pressure (SBP)	<120 mm Hg	-	-	3	100.0	0.005*

	120 ≤ SBP < 140mm Hg	5	17.9	23	82.1	
	≥140 mm Hg	1	1.4	73	98.6	
Diastolic Blood Pressure (DBP)	<80 mmHg	2	66.7	1	33.3	<0.001**
	80 ≤ DBP < 90 mmHg	2	40.0	3	60.0	
	≥90 mmHg	2	2.1	95	97.9	

NS: p > 0.05; Not significant; *p<0.05; Significant; **p<0.001; Highly significant

FIGURE LEGENDS:

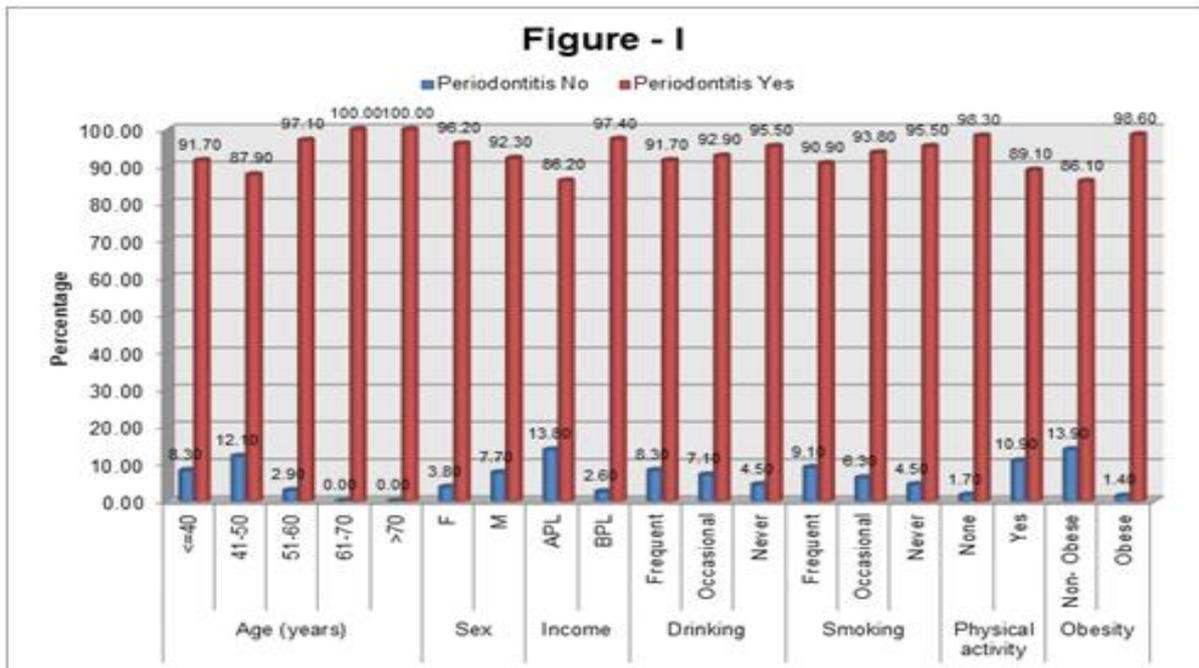


Figure 1: Relationship between periodontitis & socio-economic factors.

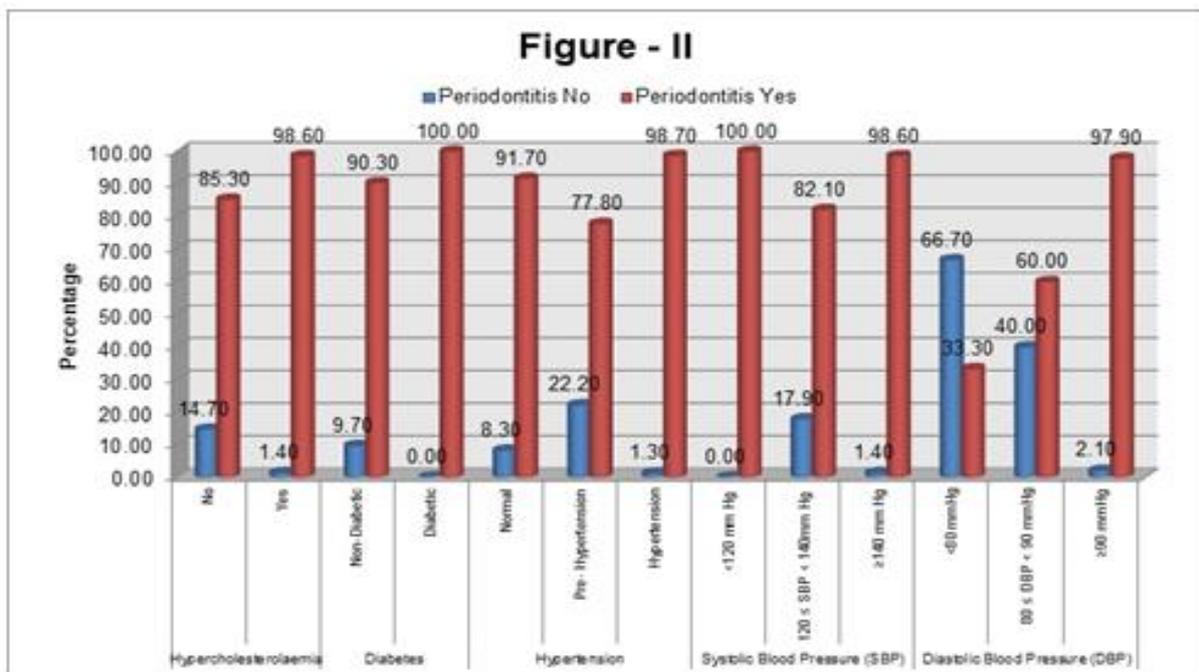


Figure 2: Relationship between diabetes mellitus and SBP and DBP with periodontitis.