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**Research Article**

# Relationship between chronic periodontitis and metabolic syndrome: a case-control study

**Manovijay Balagangadharan[1]*, Deepa Subramaniam[2], Mythili Swaminathan[3], Ravi Saranyan[1], Vel Latha Kathiresan[4], Raja Arassappan[5]**

[1]Department of Periodontia, Vinayaka Missions Sankrachariyar Dental College, Ariyanoor, Salem, Tamil Nadu, India
[2]Department of Periodontia, Sree Balaji Dental College and Hospital, Pallikaranai, Chennai, Tamil Nadu, India
[3]Dean, Raja Muthiah Dental College and Hospital, Annamalai University, Annamalai Nagar, Chidambaram, Tamil Nadu, India
[4]Department of Periodontics, CSI Dental College, Madurai, Tamil Nadu, India
[5]Department of Orthodontics, Vinayaka Missions Sankrachariyar Dental College, Ariyanoor, Salem, Tamil Nadu, India

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***Correspondence:**
Dr. Manovijay Balagangadharan,
E-mail: drmanovijaymds@yahoo.com



## ABSTRACT

**Background:** The aim of this case-control study was to investigate the periodontal status of patients with metabolic syndrome compared to general healthy individuals and to determine whether the periodontal status was consistent with the values of the metabolic components.
**Methods:** A total of ninety patients were examined in this study. Group one consisted of forty five patients who were confirmed to have metabolic syndrome and group two consisted of forty five age and sex matched healthy controls. Plaque index, Gingival Bleeding Index (Ainamo & Bay), Probing Pocket Depth (PPD), Clinical Attachment Level (CEJ), total number of missing teeth and the reasons for extraction were also noted. Medical examination and blood investigations included measurement of height, weight, waist circumference, waist-hip ratio, Body-Mass Index (BMI), serum lipid profile, fasting blood glucose and blood pressure. Metabolic syndrome was defined according to NCEP ATP III definition. The results obtained were analyzed statistically using SYSTAT html output.
**Results:** The results of the present study showed that the periodontal condition of group one patients were poor compared to group two patients. The periodontal conditioned worsened with an increase in the metabolic components.
**Conclusion:** Based on the results of our study, it can be concluded that that periodontitis and metabolic syndrome were confounding the systemic effects of each other. Dentists should counsel their patients regarding the health hazards of metabolic syndrome and periodontitis and motivate them to maintain good oral hygiene and follow healthy life-style.

**Keywords:** Chronic periodontitis, Metabolic syndrome (MS), Systemic diseases

## INTRODUCTION

Chronic periodontitis is defined as the inflammation of the gingiva extending into the adjacent attachment apparatus. The disease is characterized by loss of clinical attachment due to destruction of the periodontal ligament and loss of the adjacent supporting bone[1]. Recent studies have shown that chronic periodontitis pose a risk factor for various systemic diseases like cardio-vascular, respiratory, diabetes, obesity, adverse pregnancy outcomes and so on. Metabolic syndrome refers to the co-occurrence of certain disorders that increase the risk of

cardio-vascular disease. So considering this, the present study was designed to investigate the periodontal status of patients with metabolic syndrome compared to generally healthy individuals and to determine whether the periodontal status was consistent with the values of the metabolic components.

## METHODS

This study was conducted in the department of periodontics, rajah Muthiah dental college and hospital, Annamalai University with the help of department of medicine, Rajah Muthiah medical college & hospital, Chidambaram, Tamil Nadu, India. The study was explained to the patients and an informed consent form was obtained from them. Individuals of both genders of over 30 years of age (range 31 to 61 years) were used in the study. They were divided into two age- and sex-matched groups. The total number of patients were 90. Among them 48 were male patients and 42 were female patients. They were of similar socio economic status. Group one consisted of forty-five patients who were confirmed to have metabolic syndrome from their medical records and group two consisted of forty-five age and sex-matched generally healthy patients. Smokers and patients under prophylactic antibiotic treatment were excluded from the study. They underwent a comprehensive general medical and dental examination. All individuals were examined in a standardized way with a mouth mirror and Williams's periodontal probe. All dental examinations were performed by one specially trained dentist. Gingival Bleeding Index (Ainamo & Bay),[2] Plaque index (Silness and Loe),[3] Probing Pocket Depth (PPD)[3] and Clinical Attachment Level (CEJ)[3] at all the 6 surfaces of the tooth were measured and made to the nearest millimeter. Number of missing teeth and reasons for extraction were also noted.

Anthropometric measurements including weight, height, Hip Circumference (HC) and Waist Circumferences (WC) were measured with the subjects wearing light clothing and no shoes. Height was measured in meters, using a hard ruler installed vertically and secured with a stable base. Body weight was measured using standard portable weighing machine (1 kg was deducted from the weights recorded as an allowance for clothing). WC and HC were measured using circumference- measuring tape. Waist Circumference (WC) was measured using circumference- measuring tape. WC was measured to the nearest centimeter at the narrowest point between the umbilicus and the rib cage. Blood pressure was measured manually using sphygmomanometer. After complete recording of brief history and thorough clinical examination, patients were instructed to be on an overnight fasting. Both the groups were asked to fast for 12 hours before their blood samples were collected. 5ml of blood was withdrawn from the antecubital vein using a vacutainer and analyzed for the serum parameters. The blood samples were assessed for the variables using enzymatic methods in the medical laboratory of Rajah Muthiah medical college and hospital, Annamalai Nagar, Chidambaram.

According to the NCEP ATP III definition,[4] metabolic syndrome is present if three or more of the following five criteria are met: waist circumference over 102 cm (men) or 88 cm (women), blood pressure over 130/85 mmHg, fasting triglyceride (TG) level over 150 mg/dl, fasting High-Density Lipoprotein (HDL) cholesterol level less than 40 mg/dl (men) or 50 mg/dl (women) and fasting blood sugar over 110 mg/dl[2]. The data collected were analyzed statistically using SYSTAT Html Output.

## RESULTS

As shown in Table 1, the results of the present study showed that the BMI, WHR, blood pressure, fasting blood sugar level and serum lipid profiles were statistically significant between the groups (P value <0.001). When the general dental variables like total number of missing teeth, plaque index score, probing pocket depth, clinical attachment level and total number of sites with bleeding on probing were compared between the groups, group 1 showed both clinically and statistically higher values than group 2 (Table 2). In Table 3, the dental variables were compared according to the number of metabolic components using Kruskal-Wallis test. As the number of metabolic components increased, the severity of periodontal disease also increased. Patients who were positive of all the five metabolic components had more missing teeth, poor plaque index score and more active sites of periodontal disease than patients with three or four metabolic components (Table 3).

**Table 1: Risk factors of all subjects.**

| Variables | MS (n=45) | Control (n=45) | Mean difference | Paired 't' test | P value |
|---|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | | | |
| BMI (kg/m$^2$) | 25.95 ± 4.182 | 22.182 ± 1.847 | 3.145 | 4.510 | <0.001 |
| WHR | 0.948 ± 0.089 | 0.882 ± 0.062 | 0.066 | 4.309 | <0.001 |
| Sys. BP | 138.22 ± 13.459 | 118.711 ± 6.196 | 19.51 | 9.824 | <0.001 |
| Dia. BP | 91.222 ± 7.029 | 80.444 ± 4.110 | 10.778 | 7.693 | <0.001 |
| TG (mg/dl) | 148.200 ± 35.209 | 112.467 ± 24.700 | 35.733 | 5.032 | <0.001 |
| HDL (mg/dl) | 45.822 ± 6.404 | 46.222 ± 5.439 | -0.400 | -0.341 | 0.735 |
| FBS (mg/dl) | 148.711 ± 40.741 | 92.400 ± 7.987 | 56.311 | 9.119 | <0.001 |

**Table 2: General dental variables.**

| Variables | MS (n=45) | Control (n=45) | Mean difference | Paired 't' test | P value |
|---|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | | | |
| Missing teeth | 4.778 ± 4.908 | 1.800 ± 1.804 | 2.978 | 3.774 | <0.001 |
| Plaque index | 2.579 ± 1.598 | 1.591 ± 0.897 | 0.988 | 3.538 | 0.001 |
| PPD (mm) | 4.502 ± 0.890 | 2.858 ± 1.139 | 1.643 | 7.098 | <0.001 |
| CAL (mm) | 5.546 ± 1.013 | 2.992 ± 1.142 | 2.553 | 10.538 | <0.001 |
| BOP% | 75.254 ± 31.450 | 42.571 ± 33.405 | 32.743 | 4.568 | <0.001 |

**Table 3: Dental variables by metabolic components (*K-W test: Kruskal-Wallis test).**

| Variables | 3 components (n=16) | 4 components (n=16) | 5 components (n=13) | K-W test* | P value |
|---|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | | |
| Missing teeth | 1.937 ± 2.999 | 4.750 ± 4.389 | 8.308 ± 5.360 | 14.440 | 0.001 |
| PI | 2.566 ± 1.618 | 2.160 ± 0.923 | 3.110 ± 2.118 | 1.556 | 0.459 |
| PPD (mm) | 4.385 ± 0.882 | 4.722 ± 0.897 | 4.375 ± 0.910 | 1.338 | 0.512 |
| CAL (mm) | 5.523 ± 1.106 | 5.503 ± 0.855 | 5.626 ± 1.144 | 0.120 | 0.942 |
| BOP (%) | 72.989 ± 32.133 | 79.741 ± 31.16 | 72.519 ± 32.866 | 0.424 | 0.809 |

## DISCUSSION

The relationship between chronic periodontitis and metabolic syndrome can be bi-directional. There are many epidemiological studies that have found a constant association between chronic periodontitis and various components of metabolic syndrome.[5] In Chronic periodontitis there will be an increase in pro-inflammatory cytokines like TNFα, IL-6 and acute-phase proteins like amyloid A and C-reactive proteins.[6] The increase in TNFα and IL-6, by monocytes and macrophages in chronic periodontitis patients will alter their lipid metabolism and will lead to a hyperlipidemic state. This will further impair glucose metabolism. Recent studies have indicated that adipose tissue, especially visceral adipose tissue, is an important organ that secretes several bioactive substances known as adipocytokines.[7-10] As tumor necrosis factor-α is secreted from adipose tissue, it may enhance periodontal degradation. Plasminogen activator inhibitor-1, which is strongly expressed in visceral fat, induces the agglutination of blood and raises the risk of ischemic vascular disease. Therefore, plasminogen activator inhibitor-1 may also decrease blood flow in the periodontium of obese subjects. The periodontal disease may stimulate the systemic inflammation linked to cardiovascular disease. Moreover, the chronic inflammation and the inflammatory cytokines may cause endothelial dysfunction establishing a connection between inflammation and risk for cardiovascular disease. This connection could be mediated by alterations in the vascular resistance causing blood pressure.[11-13] The bi-directional relationship between diabetes and chronic-periodontitis is a well-established fact[14,15,].Grossi and others[16] have suggested that effective control of periodontal infection in diabetic patients reduces the level of AGEs in the serum. The relationship between periodontal disease and hyperlipidemia has already been studied by various researchers who verified that patients with periodontal disease could present elevated levels of triglycerides and cholesterol.[17-22] This is because of the systemic involvement, since the periodontal infection is a chronic one. Moreover, chronic exposure to bacteria LPS promotes the recruitment of defense cells, specifically macrophages that secrete TNF-α and IL-1β, increasing lipogenesis and lipolysis and leading to a state of hyperlipidemia. The increased lipid levels promote alterations, for example, phagocytosis and chemotaxis alterations of the defense cells (polymorphonuclear cells and macrophages). These cells release a greater amount of growth factors by the macrophages, which impair tissue healing.

Oxidative-stress seems to be a common etiologic factor in the pathogenesis of periodontitis and metabolic syndrome.[23,24] Metabolic syndrome can be associated with periodontal disease since the metabolic alterations observed in that condition can cause an exacerbated host inflammatory response, alterations in neutrophil function, and with the inhibition of macrophage growth factors, reduces tissue-healing capacity. In this way, metabolic syndrome individuals could have higher chances of undergoing tissue destruction in the presence of periodontal infection.[25] Holmflund et al.[26] in his study has mentioned that tooth loss is significantly associated with metabolic syndrome. In our study also we found that the number of missing teeth were higher in patients with metabolic syndrome. There was an increase in periodontal disease severity with an increase in the metabolic components. It may be attributed to the confounding disease activity by the components of metabolic syndrome.

Recent studies have shown that maintaining a good oral hygiene can improve overall systemic health.[27] Hence maintenance of good oral hygiene can reduce the prevalence of metabolic syndrome. Similarly following proper life-style measures with good exercise and healthy balance diet will improve both oral and systemic health.

## CONCLUSION

The present study has shown an insight on the association between chronic periodontitis and metabolic syndrome. Future studies should investigate the fact that oral hygiene care can prevent the prevalence of metabolic syndrome. Health screening by oral health providers could have a significant impact on metabolic syndrome prevention and management, as many individuals who seek dental care do not routinely seek medical care.

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