

Association of Periodontitis and Systemic Diseases

Muhammad Wasif Haq¹, Farzeen Tanwir^{2,*}, Saba Tabassum³, Madiha Nawaz⁴, Mohammad Faraz Siddiqui⁵

¹Student of Masters of Speech Pathology, Flinders University, Adelaide, Australia

²Associate Professor and Head of Periodontology Department, Ziauddin University, Karachi, Pakistan

³House Officer in Hamdard College of Medicine & Dentistry, Karachi, Pakistan

⁴Private Medical Practice, Islamabad, Pakistan

*Corresponding author: Farzeen Tanwir, Director of Post graduate Studies and Research Associate Professor, and Head, Department of Periodontology, Ziauddin University, Pakistan, E-mail: farzeen_tanwir@yahoo.com

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Abstract

Aim: To determine the frequency of periodontitis in patients with systemic diseases admitted in the hospital.

Method: This cross sectional study consists of a total of 450 patients. The data was obtained from Pakistan Institute of Medical Sciences, Capital Development Authority, Islamic International Dental College, Islamabad and Jinnah Postgraduate Medical Center, Karachi. The patients in the study were suffering from diseases such as diabetes mellitus, cardiovascular disorders (with and without diabetes mellitus), respiratory disorders, gastrointestinal disorders, hepatic disorders, renal disorders, bone/joint disorders and hypertension. Periodontal status was examined with the help of sterilized dental mirror, periodontal probe, wooden tongue depressor and torch.

Results: Systemic diseases negatively impacting periodontal status are listed in the descending order of severity: Diabetes mellitus+cardiovascular disease> Diabetes mellitus> Cardiovascular disease> Bone/joint disorders> Renal problems> Hypertension> Hepatic disease> Gastrointestinal disorders> Respiratory problems. In terms of periodontitis, 37% of population experienced mild periodontitis, 28% had aggressive periodontitis, 27% had moderate periodontitis while 8% had gingivitis.

Conclusion: The results of the study indicate the association between systemic illnesses and development of severe periodontitis. This implies that improvement of oral health can lead to betterment of the systemic health which will lead to better quality of life for the patient. Therefore we recommend collaboration between dentists and medical physicians through which focus on prevention and treatment of oral as well as systemic health can be achieved.

Keywords: Periodontitis, Systemic health, Oral health

Introduction

Oral cavity comprises of over 700 bacterial species residing as normal oral flora along with other fungal species [1]. In periods of lowered immunity, these organisms can not only cause the development of local opportunistic infections but may also initiate or aggravate the systemic illnesses. Because of the anatomical connection of mouth with respiratory and digestive tract in addition to its rich vascular supply ensures a potential source of spread of infectious agents from the mouth to the body. Furthermore, mouth serves as a passage for the entry of various pathogens through ingestion of food substances. For these reasons oral hygiene is said to be an indicator of systemic health as many of the infections and their manifestations appear initially in the mouth than elsewhere in the body [2]. However, oral care is often neglected as many consider oral hygiene to be less important than systemic health and patients visit medical practitioner more frequently than dentist [3]. This negligence on the patient's part coupled with lack of awareness and training of general medical practitioners to examine oral cavity can lead to further deterioration of oral hygiene as well and chances of finding if any systemic disease has arisen secondarily to poor oral health are missed [4].

A neglected oral hygiene can lead to excessive accumulation of plaque and calculus which can eventually result in the most common infections such as caries, gingivitis and periodontitis [5]. Periodontitis is one of the most common chronic infections occurring in the body [6]. Studies on the prevalence of periodontitis reveal as high as 90% prevalence with gingivitis affecting almost everyone [7,8]. Earlier studies conducted on

Pakistani school children showed a 100% prevalence of the periodontitis [9]. The disease significantly adds to the global burden of disease [10]. The consequences and implications of periodontitis are not only limited to the oral cavity but are far reaching. Compromised oral hygiene has been linked to an increased risk of metabolic disorders such as diabetes mellitus, cardiovascular diseases and diseases of respiratory tract, gastrointestinal tract, renal, hepatic and bone/joints [11]. Porphyromonas gingivalis; a periodontal pathogen can increase the risk for diabetes mellitus, cardiovascular disorders, preterm birth, non alcoholic liver disease as well as autoimmune antibodies formation in Rheumatoid arthritis patients [12,13]. On the other hand, severe periodontal infection can cause systemic inflammation thereby implying a bidirectional relationship between deficient oral hygiene and systemic illnesses which means that negligence of one can aggravate the disease in the other [14]. Recently it has also been shown that patients suffering from periodontitis have higher number of β -lactamase producing microorganisms, therefore, improvement of oral hygiene can lead to better response of the body to therapy and medications thereby improving overall health of the body [15].

The aim of this study, which is a part of research project on association of periodontitis with systemic illnesses, was to evaluate the association of periodontitis in patients suffering from various systemic illnesses admitted in the hospitals. To the authors' knowledge, there has been insufficient data recorded in Pakistan about association of periodontitis in patients with different systemic diseases.

Materials and Methods

The ethical approval for this observational study was obtained from Ethics committee at Ziauddin University, Karachi, Pakistan. The sample size was determined by online sample size calculator by Raosoft. The resulting recommended sample size was 377, which were increased to 520 for more accuracy. Data collection was done between the months of July-November 2012 from two public sector; tertiary care hospitals in Islamabad namely Pakistan Institute of Medical Sciences (P.I.M.S.), Capital Development Authority (C.D.A.) hospital, outpatient department at Islamic International Dental College and Hospital, Islamabad and Jinnah Postgraduate Medical Center (J.P.M.C.) Karachi, which is also a public sector, tertiary care hospital. Patients from nine systemic illnesses were chosen for this study which is listed in (Table 1).

Conscious patients having permanent dentition and suffering from one disease were selected for the study after taking informed consent. Patients with acute infections, pain, pregnancy, loss of teeth due to trauma or any accident and total absence of teeth were excluded which resulted in total sample size of 450 patients. For every disease; 50 patients were chosen. The patients were asked about their disease and the reason for visiting hospital. Their medical reports were assessed to rule out co-morbidities.

Dental examination was performed using sterilized dental mirror, periodontal probe, wooden tongue depressor and a torch light. Data for systemic disease and periodontal status was recorded for every patient. The normal number of teeth was taken to be 28 excluding 3rd molars for this study.

According to Periodontal disease classification, gingivitis was taken as inflammation of gums. Periodontitis (generalized with > 30 % sites covered) is categorized as mild, moderate and aggressive, with mild having 1-2 mm of CAL and moderate being 3-4mm and aggressive being >5 mm of CAL (clinical attachment loss). (AAP: Annals of Periodontology- Vol 4.Classification).

For statistical analysis, Statistical Package for Social Sciences (S.P.S.S.) version 16 was used to calculate the mean for each variable along with

Disease	Conditions Present
Diabetes Mellitus (D.M.)	Type 1 & Type 2
Cardiovascular disorders (C.V.S.)	Myocardial infarction, Angina Pectoris
Respiratory disorders	Tuberculosis, Asthma, Chronic obstructive pulmonary disease (C.O.P.D.), Pneumonia
Gastrointestinal disorders (G.I.)	Gastric ulcer, Gastritis, Inflammatory bowel disease, Typhoid.
Hepatic disorders	Hepatitis B & C, Hepatocellular carcinoma.
Renal disorders	Chronic kidney failure, proteinuria.
Bone/joint disorders	Rheumatoid arthritis, osteoarthritis, osteoporosis.
Hypertension (H.T.N.)	Primary hypertension
Diabetes Mellitus + Cardiovascular patients (D.M.+ C.V.S.)	Diabetic patients with co-morbid heart disease.

Table 1: Systemic diseases chosen for the study along with the most frequent forms of the disorders seen in the sample.

the standard error. Mean age of the sample was calculated. The mean for periodontal diseases for each systemic disease along with standard deviation was estimated. Kruskal Wallis test was used to find degree of statistically significant association between systemic diseases and periodontal diagnosis, followed by Mann-Whitney U test to determine p value between diseases. The level of significance was set at $p < 0.05$ (95% confidence interval).

Results

There were equal number of males and females in the selected sample of 450 patients with the mean age of 43.28 years (± 14.45) and the age range as 13-84 years. 92% of the sample has periodontitis while 8% had gingivitis (Graph 1).

Periodontally majority of the patients had mild form of periodontitis while 27% and 27% had moderate and severe periodontitis respectively. Diabetic patients with or without associated C.V.S. problems had highest score of periodontal problems which did not differ from scores obtained for C.V.S. and bone/joint diseases patients. In both the categories of D.M.; with and without C.V.S. problems, the maximum number of patients had aggressive periodontitis (Graph 2). D.M. appears to be the only disease in the current study in which none of the patient had gingivitis suggesting the prevalence of periodontitis as high as 100% in diabetics included.

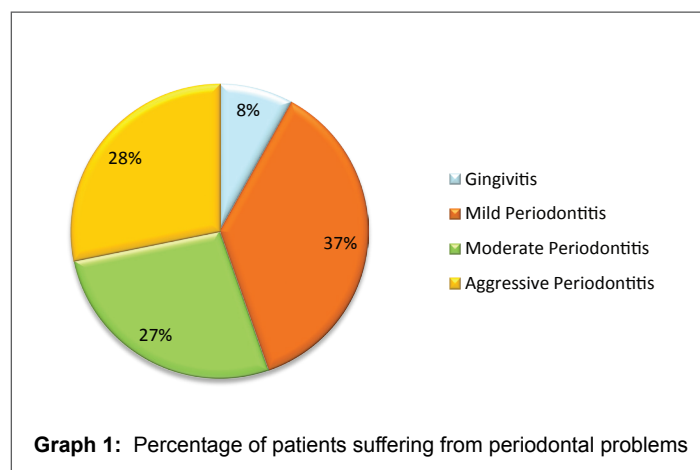
Cardiovascular patients had relatively better oral hygiene compared to D.M. patients, though the difference was non significant (Graph 2, Table 3). The C.V.S. patients in the present study had moderate to aggressive periodontitis (Graph 2). There were no significant differences between C.V.S. patients and patients of D.M., D.M.+C.V.S., renal, bone/joint problems and H.T.N. suggesting a similar pattern of oral health as that of C.V.S. patients amongst all these.

The sample with bone/joint diseases such as osteoporosis, osteopenia and arthritis; osteoarthritis and rheumatoid arthritis also had higher prevalence of periodontitis in the study (Table 2).

After D.M., bone/joint disease is the only disease with least number of patients suffering from minimal level of periodontal disease (Graph 2).

Maximum number of renal patients had moderate periodontitis (Graph 2). H.T.N. patients had similar periodontal health as renal patients with equal number of patients with mild and moderate periodontitis (Graph 2).

In this study, majority of hepatic patients had mild periodontitis with only 5 patients suffering from aggressive periodontitis.



Graph 1: Percentage of patients suffering from periodontal problems

Except for respiratory and G.I. diseases patients; there were significant differences with all other diseases (Table 3).

Patients with respiratory disorders had least effect on periodontal health as few patients suffered aggressive periodontitis (Graph 2). Most of the G.I. patients suffered from mild periodontitis and this disease has a maximum count in gingivitis (Table 3).

The results from the current study show a relatively weak association between periodontal health and G.I. disorders (Table 3, Graph 2). The comparisons between oral healths in patients with various systemic diseases along with the p-value are shown in Table 3. Periodontal status for each disease category is represented individually in Graph 2.

Discussion

There is highly significant association between periodontal and systemic diseases ($p=0.00$). It can be seen that systemic diseases always affect oral hygiene negatively as none of the patient had sound oral health (Graph 1). Periodontally majority of the patients had mild form of periodontitis while 27% and 27% had moderate and severe periodontitis respectively.

Diabetic patients with or without associated C.V.S. problems had highest score of periodontal problems which did not differ from scores obtained for C.V.S. and bone/joint diseases patients. The non significant association between D.M. and D.M. + C.V.S., C.V.S. patients and bone/joint patients imply that periodontal health of patients suffering from these systemic diseases is alike (Table 3). Both types of D.M. are known risk factor for periodontitis and periodontitis is cited as the 6th most common complication of D.M. [16,17]. The poor blood sugar control puts diabetic patients at 2.8 times higher risk of periodontitis and almost 4.2 times at risk of alveolar bone loss relating hyperglycemia with increased chances of periodontitis [18]. On the other hand, improvement in oral hygiene is associated with a better control of blood sugar and a subsequent decline in the diabetes related complications such as retinopathy, neuropathy, proteinuria, C.V.S. complications and ketoacidosis [16,18]. Severe periodontal disease can increase mortality by diabetic nephropathy 8.5 times compared to people with mild to moderate periodontal disease [19]. In D.M. patients, periodontitis is a predictor of mortality from ischemic

heart disease. Studies have shown higher periodontal inflammation in diabetic patients and poor glycemic control is in turn linked with periodontal attachment loss leading to tooth loss [19,20]. In both the categories of D.M.; with and without C.V.S. problems, the maximum number of patients had aggressive periodontitis (Graph 2). D.M. appears to be the only disease in the current study in which none of the patient had gingivitis suggesting the prevalence of periodontitis as high as 100% in diabetics included. The oral health of diabetic individuals should be given special care as periodontitis can also increase the resistance to insulin [21]. This may cause increased risk for D.M. in periodontitis patients as well can cause exacerbation of diabetes in diabetic patients [22].

Cardiovascular patients had relatively better oral hygiene compared to D.M. patients, though the difference was non significant (Graph 2, Table 3). Numerous studies have found association between C.V.S. and periodontal disease with one study suggesting 25-90% increased risk of C.V.S. disorders in patients with severe periodontitis [20]. Another study showed that 91% of cardiovascular patients have moderate to severe periodontitis [23]. Poor oral hygiene can produce bacteremia when patient chews food or brushes teeth which can lead to increased inflammatory cytokine production in the body, the level of bacteremia being proportional with the degree of inflammation and infection in the oral cavity [24,20]. Therefore, it is suggested that patients at risk of infective endocarditis and cardiovascular disorders should maintain best possible oral hygiene. Not only C.V.S. disease is a risk factor for periodontitis, the latter also increases the risk of thrombus and atherosclerosis as people who suffered from C.V.S. ischemia; non hemorrhagic stroke have always some form of periodontitis [25-27]. Oral bacteria such as *Streptococcus sanguis* and *Porphyromonas gingivalis* induce platelet aggregation and promote thrombus formation [28]. Likewise; periodontal pathogens have also been identified in atherosclerotic lesions listing periodontitis as a risk factor for C.V.S. disease [29]. The C.V.S. patients in the present study had moderate to aggressive periodontitis (Graph 2). There were no significant differences between C.V.S. patients and patients of D.M., D.M.+C.V.S., renal, bone/joint problems and H.T.N. suggesting a similar pattern of oral health as that of C.V.S. patients amongst all these.

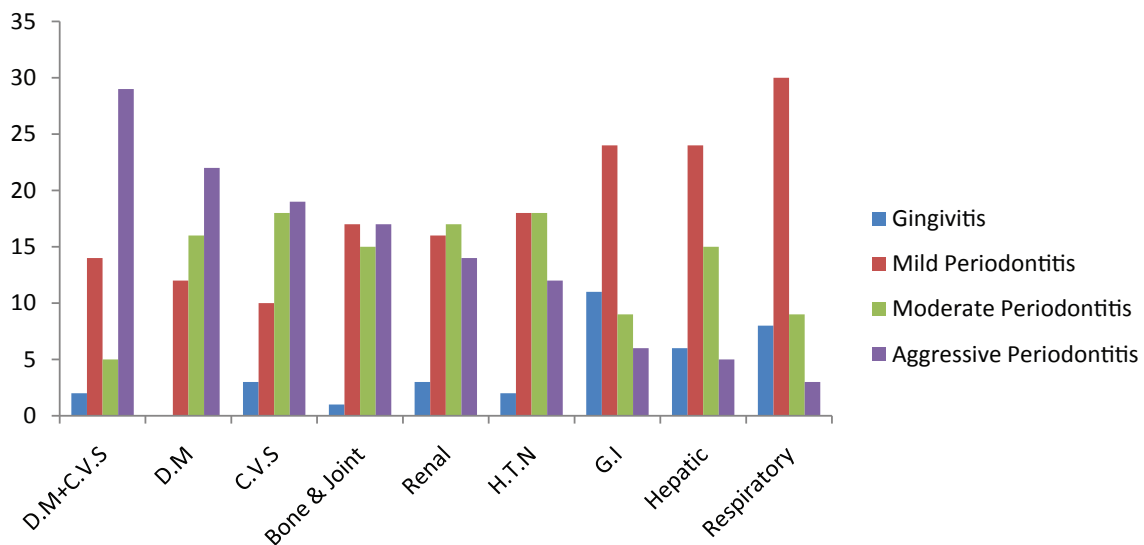
The sample with bone/joint diseases such as osteoporosis, osteopenia and arthritis; osteoarthritis and rheumatoid arthritis also had higher

Disease	D.M	C.V.S	Respiratory	G.I	Hepatic	Renal	Bone/Joint	H.T.N	D.M+CVS	P value
Diagnosis	3.2 (0.81)	3.1 (0.91)	2.14 (0.80)	2.2 (0.93)	2.38 (0.83)	2.84 (0.91)	2.96 (0.90)	2.8 (0.86)	3.2 (0.99)	0.00

Table 2: Periodontal score of patients suffering from various systemic diseases along with the p value and SD. 1= Gingivitis, 2= Mild periodontitis, 3= Moderate periodontitis, 4=Aggressive periodontitis.

Disease	C.V.S	Respiratory	G.I	Hepatic	Renal	Bone & Joint	H.T.N	D.M+CVS
D.M	0.51	0.00	0.00	0.00	0.05	0.18	0.02	0.62
C.V.S	-	0.00	0.00	0.00	0.20	0.49	0.11	0.27
Respiratory		-	0.88	0.12	0.00	0.00	0.00	0.00
G.I			-	0.23	0.00	0.00	0.00	0.00
Hepatic				-	0.01	0.00	0.02	0.00
Renal					-	0.55	0.78	0.03
Bone & Joint						-	0.38	0.11
H.T.N							-	0.02

Table 3: Comparison of oral health between patients of systemic diseases



Graph 2: Periodontal status of patients with systemic diseases represented individually.

prevalence of periodontitis in the study (Table 2). After D.M., bone/joint disease is the only disease with least number of patients suffering from minimal level of periodontal disease (Graph 2). The bone loss is a common characteristic between periodontitis and osteoporosis due to which a possible association between the two is often rejected [30]. Many studies have presented significant association between estrogen deficiency and periodontitis [31,32]. It has been seen that in periodontitis; osteoblasts cells decrease in number while osteoclastic activity is stimulated which can increase the chances of developing osteoporosis in periodontitis patients [33,34]. The degree of periodontal inflammation is also higher in postmenopausal women affected with osteopenia and osteoporosis [35,36]. A decline in alkaline phosphatase is associated with periodontal attachment loss [37]. The degree of periodontitis is directly linked with severity of rheumatoid arthritis and improving oral health leads to reduction in severity of rheumatoid arthritis [38,39]. In the current study, the patients of respiratory, G.I. and hepatic disorders were significantly different from bone/joint diseases patients.

Maximum number of renal patients had moderate periodontitis (Graph 2). Periodontally; significant findings were seen with D.M., D.M.+C.V.S., hepatic, G.I. and respiratory patients. It has been reported that predialysis and hemodialysis patients have severe periodontitis [40]. Similarly causative link between glomerulonephritis and periodontitis has also been observed [41]. Patients with hyperoxaluria and uremia have poor oral hygiene, greater alveolar bone loss which causes tooth loss as well [42,43]. Regarding tooth loss; nephropathy is a risk factor for partial tooth loss and edentulous patients are found to be commonly suffering from chronic kidney disease [44,45]. Chronic renal failure increases plaque level which if persists can lead to periodontal problems [5,46]. However, some studies have observed no significant results linking kidney disorders with periodontitis [47,48].

H.T.N. patients had similar periodontal health as renal patients with equal number of patients with mild and moderate periodontitis (Graph 2). The poor oral health is linked to elevation of blood pressure in H.T.N. patients and consequently causes poor blood pressure control in the older patients [49,50]. There have been refuting reports as well which do not establish any link between the two [51]. H.T.N. favors the development of

periodontitis and severe periodontitis in turn is associated with elevation of blood pressure which can increase the left ventricular mass [52-54]. The disease differed significantly with D.M., D.M.+C.V.S., hepatic, G.I. and respiratory disorders.

Regarding the possible association between periodontitis and liver diseases; C-reactive protein increases in patients with periodontitis [55]. This increased synthesis can be due to local production of the inflammatory protein by the diseased gingival tissue or by the liver enhancing thereby the risk of C.V.S. disorder due to atheroma formation [27,28,56]. This implies that some systemic diseases may raise the chance of other systemic diseases which in turn are also linked with periodontitis. In males affected with periodontitis, an increase in alanine aminotransferase was observed, however authors found no such rise in the enzyme in female population [57]. In a study, Hepatitis C patients were reported to have poor oral hygiene [58]. Several periodontal bacteria have been isolated in patients with pyogenic liver abscess and improving the oral hygiene reduces liver injury and mortality in chronic liver disease patients [59-61]. In this study, majority of hepatic patients had mild periodontitis with only 5 patients suffering from aggressive periodontitis. Except for respiratory and G.I. diseases patients; there were significant differences with all other diseases (Table 3).

Patients with respiratory disorders had least effect on periodontal health as few patients suffered aggressive periodontitis (Graph 2). The literature states that oral bacteria can be aspirated to cause pulmonary infections and dental plaque can initiate as well as aggravate pneumonia [62,63]. Chlamydomphila pneumonia; a pathogen involved in pneumonia is shown to increase chances for periodontitis as well as atherosclerosis [64,65]. There has been discussion about poor periodontal health in asthmatic individuals and the decrease in bone density especially in mandible in patients using inhaled corticosteroids [66]. Periodontal attachment loss can also cause a decrease in lung function [67]. Maintaining good oral hygiene in C.O.P.D. patients decreases the frequency of exacerbation in chronic periodontitis patients which relates periodontitis as a risk factor for C.O.P.D [68,69]. In C.O.P.D. patients; chronic gingivitis is a common finding [70]. In the current study; majority of the patients remained on lower end of periodontal diseases (Graph 2) with only 3 patients having

aggressive periodontitis. The disease was non-significantly related to G.I. and hepatic disorders only.

Most of the G.I. patients suffered from mild periodontitis and this disease has a maximum count in gingivitis (Table 3). Oral bacteria are related to G.I. diseases and likewise. *Helicobacter pylori* is said to exist in greater number in oral cavities of gastric ulcer patients and it can cause poor oral health [71,72]. This bacterium is said to produce Hydrogen sulfide which causes oral malodour [73]. Recent evidence has linked Hydrogen sulfide with increased risk of alveolar bone resorption due to increased osteoclastic cell activation [74]. As alveolar bone resorption is a characteristic feature of periodontitis; *H. pylori* is found increasingly in oral cavities of patients suffering from periodontitis [75]. There have also been some reports associating the bacteria with Insulin resistance which can increase the chances of D.M [76]. Prevalence of periodontitis in inflammatory bowel disease, Crohn's disease and ulcerative colitis is also high suggesting that G.I. disorders impact oral hygiene negatively [77,78]. The results from the current study show a relatively weak association between periodontal health and G.I. disorders (Table 3, Graph 2). The non-significant association was observed with hepatic and respiratory patients only in this study.

The strength and weakness of the study deserve mention. This is the first study to assess the severity of periodontitis in patients with multiple systemic illnesses. The sample size was increased to have better evaluation of periodontal health status. The weaknesses of the study include failure to include lab tests of different biomarkers of systemic and periodontal disease, which will be considered for our ongoing project. Another limitation is healthy subjects will be added and compared with the patients suffering from various diseases, which is necessary to know the baseline prevalence of Periodontitis among the people of Pakistan.

Conclusion

The periodontal health of patients experiencing systemic illnesses was noted to be extremely worse. The bidirectional relationship between periodontal diseases and systemic illnesses imply that improving oral health can lead to betterment of systemic health. Therefore it is the need of the hour to form collaborative units between dentists, general physicians and specialists to focus not only on systemic health but also on oral health. Many of these diseases can be prevented and improved by improving oral hygiene; therefore, it is the need of the hour.

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