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Prevalence of Periodontal Disease among Patients with Chronic Kidney Disease

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ABSTRACT

Background: Periodontal diseases can have a significant effect on the systemic health. Chronic systemic diseases such as chronic kidney diseases of different stages may also influence progression of periodontal disease. The present study assessed the prevalence of periodontal disease among a group of patients with renal disease and compared their periodontal status to that of healthy controls.

Materials and methods: 50 patients with different forms of chronic kidney disease and 50 healthy controls were examined for oral hygiene status, gingival inflammation, probing pocket depth and clinical attachment loss. The subjects were grouped into four as no, mild, moderate and severe periodontitis.

Results: Most of the periodontal parameters were significantly elevated in the case group as compared to controls ($p < 0.05$). The prevalence and severity of periodontal disease was also higher in the case group letter being statistically significantly ($p < 0.05$).

Conclusions: This study gives a snap shot of proportion of periodontal diseases in Chronic Kidney Disease (CKD) patients of different stages. It also provides information about degree of periodontal diseases in CKD.

GRAPHICAL ABSTRACT

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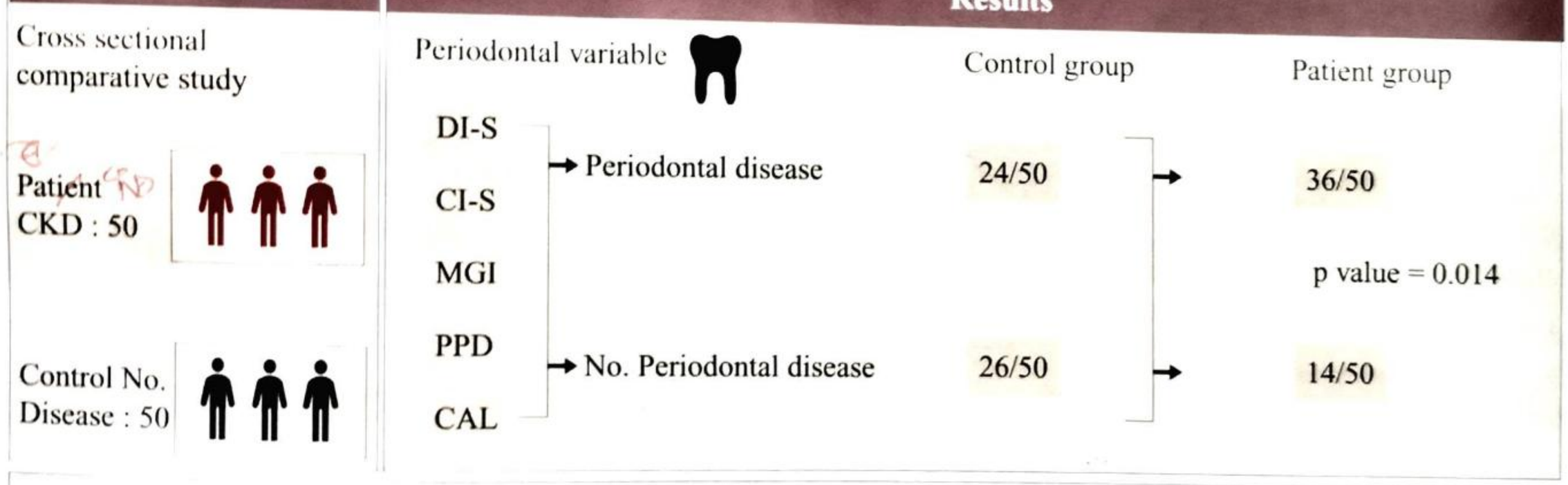

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INTRODUCTION

Periodontal diseases comprises of a group of inflammatory diseases affecting the supporting tissues of the teeth resulting from a complex interplay of specific gram-negative microorganisms, their byproducts and the host-tissue response. This results in progressive destruction of the periodontal ligament and alveolar bone. Earlier, periodontitis had been considered as a

disease confined to the oral cavity. However, in the past several years, substantial scientific data have emerged to indicate that the localized infections characteristic of periodontitis can have a significant effect on the systemic health.

It is now recognized that the periodontopathic gram-negative bacteria and bacterial products, such as lipopolysaccharides, activate the host immune response significantly and their actions have consequences beyond periodontal tissues. Pro-inflammatory cytokines, such as α_2-macroglobulin, α_1-antitrypsin and C-reactive protein are significantly elevated during the destructive phase of periodontitis.[1-3] These inflammatory mediators may have a profound influence in the pathogenesis of many systemic diseases.

During the past decade, numerous studies, mostly cross-sectional and few longitudinal, have been carried out and they provide evidence for the link between periodontal and cardiovascular diseases, like atherosclerosis and myocardial infarction.[4-6] Recently, several studies have been published in the literature, providing evidence for an increased prevalence of periodontal disease in patients with renal disease, especially in dialysis patients, and renal transplant recipients.[7-12]

However, conflicting results regarding the periodontal status of these patients are also available and further studies are warranted in this regard.[13-15] The aim of the present study was to know the prevalence of periodontal disease among a group of patients with chronic renal disease. Furthermore, we wanted to compare their periodontal status to that of healthy controls.

MATERIALS AND METHODS

This study was designed as a cross-sectional comparative study. Cases were identified from the patients attending the outpatient clinic at the Department of Nephrology, Chittagong Medical College, Chattogram, over a period of six months, from March 2019 to August 2019. Only patients who were diagnosed with renal disease were included. These diseases include chronic kidney disease of varied etiology. Systemically healthy individuals who accompanied patients during the same period were selected as control subjects.

Subjects who had previously underwent dialysis or renal transplantation were excluded from the study. Subjects with history of hepatitis, those who had received periodontal therapy or systemic antibiotic therapy within a period of six months prior to the examination and subjects with any acute condition that contraindicated a periodontal examination were also excluded. To assess the periodontal status, all subjects were required to have at least six natural teeth.

The study was conducted by the joint efforts of the Departments of Nephrology, Chittagong Medical College, and the Department of Periodontology, Dental Unit, Chittagong Medical College. The study was approved by the Ethical Review Committee, Chittagong Medical College, Chattogram. A written informed consent was obtained from all participants in the study.

All subjects were required to answer a detailed questionnaire. The information collected included demographic characteristics like name, age, address, sex, occupation etc. A detailed medical and dental history was also collected from all subjects.

The dental and periodontal examination in all subjects was carried out by one of the authors. The dental status was determined by visual examination under direct and indirect illumination, using a plane dental mirror and a dental explorer. Oral Hygiene Index-Simplified (OHI-S) (Greene and Vermillion) was calculated for assessing the oral hygiene status.[16] The index was calculated using six index teeth: 16, 11, 26, 36, 31, 46. Modified Gingival Index (MGI) for the entire dentition were calculated as a measure of gingival inflammation.[17]

The periodontal examination was carried out with calibrated periodontal index probes with markings (Fig.1). The periodontal status was determined using measurements of Probing Pocket Depth (PPD) Gingival Recession and Clinical Attachment Level (CAL) measurements from four sites on each tooth (Buccal, mesial, lingual/palatal & distal). PPD was taken as the distance from the gingival margin to the base of the gingival sulcus / periodontal pocket. Gingival recession was measured as the distance from the cemento-enamel junction to the gingival margin on the root surface. These scores were then added up to indirectly obtain the values for CAL. The measurements were calculated using six index teeth: 16, 12, 46, 36, 41, 44.

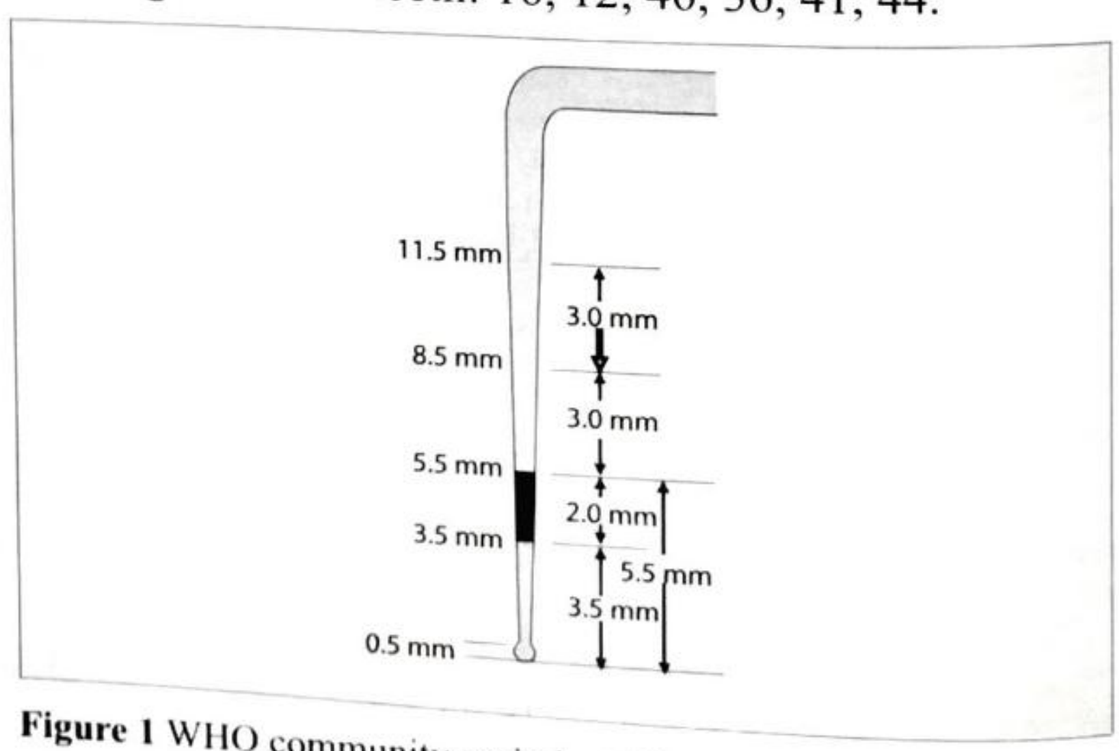

Figure 1 WHO community periodontal index probe

All the subjects were categorized into four groups (No, Mild, Moderate & Severe Periodontitis) based on CAL and PPD measurements, using the criteria proposed by the joint working group of the Centre for Disease Control and Prevention in collaboration with the American Academy of Periodontology in 2003 which are depicted in (Table I).

Table I Clinical case definitions proposed by the CDC Working Group for Use in Population-Based Surveillance of Periodontitis[18]

Category	Clinical Attachment Level (CAL)	Probing Pocket Depth (PPD)
Severe Periodontitis	≥ 2 interproximal sites with and (Not on same tooth) CAL ≥ 6 mm	≥ 1 interproximal site with PD ≥ 5 mm
Moderate Periodontitis	≥ 2 interproximal sites with or (Not on same tooth) CAL ≥ 4 mm	≥ 2 interproximal sites with PD ≥ 5 mm
No or Mild Periodontitis	Neither "moderate" nor "severe" periodontitis	

Variables studied:

Independent variables (Cases):

Socio-demographic variables

Age, Sex, Marital status, Races, Socio-economic class (Education-Profession-Family income), BMI (Height & weight

CKD related variables

eGFR & CKD staging, Types of CKD

Periodontal variables:

Debris index simplified (DI-S),
Calculous index simplified (CI-S)
OHI-S, MGI, PPD, CAL

Dependent variables (Periodontal status)

No Periodontitis
Mild Periodontitis
Moderate Periodontitis
Severe Periodontitis

Descriptive statistics including mean values for OHI-S, modified Gingival Index, PPD and CAL were calculated. For comparisons between the case and control groups, the Student's t-test and chi- square tests were used for quantitative and qualitative variables respectively. The difference in proportions in both groups was tested using chi-square test. All statistical analyses were carried out using Statistical Package for the Social Sciences package for Windows, Version 26. The 95% confidence intervals was considered as (p-value < 0.05) statistical significant.

Prior to the commencement of this study. The research protocol was approved by the IRB of Chittagong Medical College, Chattogram.

RESULTS

A total of 100 patients were included in the study (50 in each group). The mean age of patients was 43.02± 14.89 years. There were a total of 72 males and 28 females in the study. The group wise distribution of age and gender & other baseline characteristics of the subjects are depicted in (Table II). Significant difference was found between the distributions of age, gender, DI-S, & OHI-S among the groups. Fig. 2 shows the distribution of different forms of renal disease among the case group.

Table II Frequency of baseline characteristics (Independent variables)

	Case n (%)	Control n (%)	*p-value (2-tailed)
Gender			
Male	44 (88)	28 (56)	0.000
Female	6 (12)	22 (44)	
Age (Years)			
Range	15-79	15-77	
Mean ± SD	49.82±16.38	36.22±13.39	0.000
15-24	4 (8)	12 (24)	0.000
25-34	5 (10)	14 (28)	
35-44	10 (20)	8 (16)	
45-54	6 (12)	11 (22)	
55-64	13 (26)	4 (8)	
65	12 (24)	1(2)	
Modified Kuppuswamy Socio-demographic status (Education, income, profession)			
Lower middle class	32 (64)	22 (44)	0.112
Upper middle class	17 (34)	25 (50)	
Upper class	1 (2)	3 (6)	
Marital status			
Married	44 (88)	39 (78)	0.183
Unmarried	6 (12)	11 (22)	
BMI & Weight category			
BMI (Mean ± SD)	24.25 ± 4.54	25.35 ±5.64	0.335
Underweight	3(6)	4(14.81)	0.165
Ideal weight	27(54)	8(29.63)	
Overweight	10(20)	9(33.33)	
Obese	10(20)	6(22.22)	
Races			
Muslim	44(88)	45(90)	0.490
Hindu	6(12)	4(8)	
Others	0	1(2)	
Periodontal status			
DI-S status			
Good	1(2)	5(10)	0.0012
Fair	26 (52)	38(76)	
Poor	23(46)	7(14)	
CI-S status			
Good	1(2)	2(4)	0.109
Fair	45(90)	48(96)	
Poor	4(8)	0(0)	
OHI-S status			
Good	1(2)	2(4)	0.006
Fair	25(50)	39(78)	
Poor	24(48)	9(18)	
MGI status			
No gingivitis	4(8)	0(0)	0.103
Mild gingivitis	33(66)	29(58)	
Moderate gingivitis	9(18)	14(28)	
Severe gingivitis	4(8)	7(14)	

*'t' test for means ± SD & χ^2 - test for frequency distributions.

Mean values for OHI-S, MGI, PPD and CAL are given in table III. OHI-S & CAL values were significantly elevated in the case group as compared to controls ($p < 0.05$).

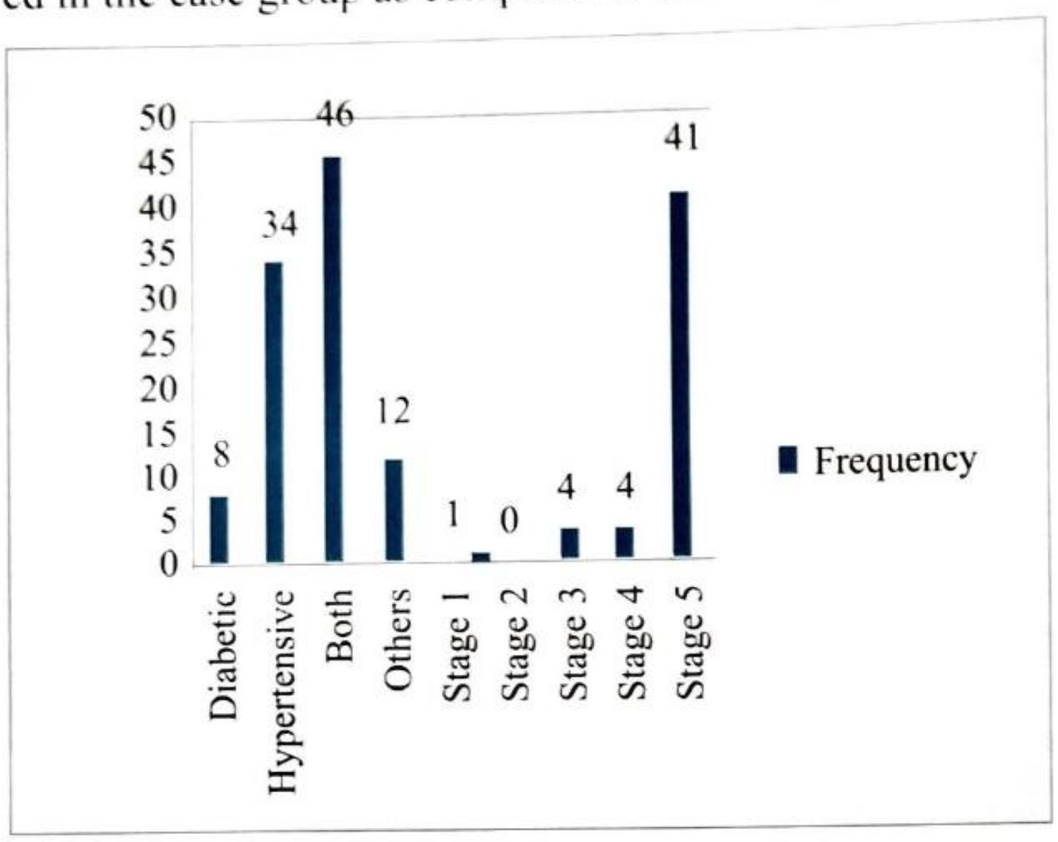

Figure 2 Distribution of renal disease & staging in case group

Table III Mean values for periodontal parameters in both groups

	Case group	Control group	#p-value
OHI-S	2.97±0.88	2.38±0.59	0.002
MGI	1.78±1.09	2.3±1.02	0.015
PPD	2.66±0.66	2.85±0.53	0.116
CAL	3.75±1.53	2.61±1.28	0.000

#Students" t-test (2-tailed value).

Table IV Distribution of periodontal disease severity in case & control group

Severity	Case (Frequency)	Control (Frequency)	*p-value
No Periodontitis	13 (26%)	19(38%)	
Mild Periodontitis	1 (2%)	7(14%)	
Moderate Periodontitis	30 (60%)	19(38%)	0.014
Severe Periodontitis	6 (12%)	5(10%)	
Total	50 (100)	50(100)	

*Chi-square test, p-value at No periodontitis (No & mild level) to Periodontitis (Moderate to severe level) level.

Table IV indicates the severity of periodontal disease in both case & control group. In the case group; 36 patients (72%) of the total 50 had moderate to severe periodontitis and the remaining patients (14, 28%) belonged to the category Mild/No Periodontitis. In the control group 26 of the 50 subjects (52%) belonged to the category of Mild/No Periodontitis, only 24 (48%) subjects had moderate to severe periodontitis. When the proportion of moderate to severe periodontal disease between the groups were compared using a chi-square test, it was observed that the prevalence and severity of periodontal disease was significantly higher in the case group as compared to the controls ($p < 0.05$).

DISCUSSION

Periodontal disease results from the interaction between specific bacteria existing in the dental plaque biofilm with components of host immune response in susceptible individuals. The inflammatory lesion in periodontitis extends from the gingiva to deeper connective tissues resulting in periodontal pockets and loss of alveolar bone. The periodontal pocket serves as a portal of entry for pathogenic bacteria and their products into the systemic circulation. The large surface area of the aggregate periodontal lesion thus serves as a significant source of inflammation in patients with moderate or severe periodontitis.[19]

A large body of epidemiological evidence provides proof that the systemic chronic inflammatory burden of periodontal disease contributes to endothelial injury and atherosclerosis, perhaps mediated by the acute phase reactants.[20] Previous studies have shown that chronic inflammation contributes to progressive atherosclerosis in patients with End-Stage Renal Disease (ESRD) undergoing hemodialysis.[21] Available data suggest that pro-inflammatory cytokines and the acute phase response play a central role in the genesis of both malnutrition and cardiovascular complications in these patients.[22] Emerging evidence also suggest that periodontal disease may provide a covert source of systemic inflammation in these patients and it may, in fact, predict the development of ESRD and the development of overt nephropathy in diabetic patients.[19,23] A recently conducted longitudinal study demonstrated that periodontal disease is a significant nontraditional risk factor for chronic kidney disease.[24]

Our study compared the periodontal health status of patients with different forms of renal disease to that of healthy controls. The results of the present study indicate that a greater prevalence and severity of periodontal disease exists in patients with renal disease. Although many previous authors have obtained similar results, conflicting reports are also available and they have failed to detect any difference in the periodontal health in patients underwent hemodialysis.[7-15] In the present study, the periodontal parameters (OHI-S and CAL) were elevated in the case group as compared to the control group and the results were statistically significant at ($p<0.05$). The periodontal destruction as indicated by elevated PPD and CAL levels, CAL is significantly worse in the case group (3.75 +1.53) as compared to the controls (2.61 + 1.28).

Low Periodontal parameters MGI & PPD in case group could be explained by the actions of antibiotic therapy most of the patients already were taking. This may exert a bit low periodontal severity in case group. Still the prevalence of moderate to severe periodontitis in the case group (72%) is very high as compared to that in controls (48%). While earlier authors have conducted similar studies in dialysis populations; our study population included only predialytic patients.[8,11,13]

The prevalence obtained in the present study is greater than that observed by previous studies in hemodialysis patients (58.9% and 25.9%)[4,9,7] and in chronic ambulatory peritoneal dialysis patients (67.3%). Therefore, our study result confirms our hypothesis that a greater prevalence and severity of periodontal disease exists in patients with renal disease as compared to systemically healthy controls. It might be possible that severe periodontal inflammation in these patients could have also contributed to the level of their renal disease burden.

The systemic disease burden could have also influenced the progression of periodontal disease in these patients. It has been already established that the chronic renal condition could have significant effects on the prevalence and severity of periodontal disease.[15,25] A recent study conducted in a Japanese population suggests that the increased incidence of chronic renal failure that occurs with age might increase the probability of severe periodontal disease in community-dwelling elderly subjects.[25] The authors also postulate that periodontal disease is influenced by chronic renal failure because of insufficient bone metabolism. Earlier studies provide evidence that vitamin D polymorphisms may predispose to both chronic kidney disease and periodontitis.[26] Hence, it is possible that periodontal disease and chronic kidney disease might share common risk factors.

LIMITATIONS

Our study, being cross-sectional in design, does not establish a cause and effect relationship. Therefore, further studies are necessary to elucidate the complex relationship between these chronic diseases.

Another limitation of this study is that the case group included subjects with diabetic kidney disease. This may be regarded as a confounder as diabetes mellitus is a risk factor for both, renal and periodontal disease.

CONCLUSION

This study provides evidence for a greater prevalence and severity of periodontal disease among predialytic patients with renal disease. As periodontal evaluation is not performed as part of routine medical assessment in these patients, the periodontal source of inflammation may be overlooked.

RECOMMENDATION

Further research with well controlled randomized clinical trials is necessary to establish whether early detection of periodontal disease followed by effective periodontal therapy will actually result in decreased in atherosclerotic complications in patients with renal disease.

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CONTRIBUTIONS OF AUTHORS

PD-Conception, design, critical revision of contents & final approval.

MKU- Design, acquisition of data, drafting, data analysis, data interpretation & final approval.

DISCLOSURE

Both the authors declared no competing interest.

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