

Periodontal disease as a predictor of chronic kidney disease (CKD) stage in older adults

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Abstract

Objective: The aim of this study was to evaluate periodontal disease as a predictor of chronic kidney disease (CKD) stage in older adults.

Methods: A total of 1159 adults aged 65 to 80 years and diagnosed with periodontal disease and CKD (stages 1, 2, and 3) were randomly selected for a cross-sectional study. Periodontal status was assessed using the Community Periodontal Index of Treatment Needs (CPITN) and CKD was staged using the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF-KDOQI) guidelines.

Results: In patients with stage 1 CKD, the odds ratios (ORs) (95% confidence intervals [CIs]) for CPITN-1, CPITN-2, CPITN-3, and CPITN-4 were 1.13 (0.83–1.55), 1.47 (1.13–1.81), 1, and 1, respectively. In patients with stage 2 CKD, the ORs (95% CIs) for CPITN-1, CPITN-2, CPITN-3, and CPITN-4 were 1.49 (1.14–1.93), 1.37 (1.02–1.78), 3.07 (2.81–3.25), and 3.65 (3.49–3.71),

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respectively. In patients with stage 3 CKD, the ORs (95% CIs) for CPITN-1, CPITN-2, CPITN-3, and CPITN-4 were 1, 1, 4.61 (4.47–5.21), and 5.23 (5.14–5.47), respectively.

Conclusion: The highest CPITN values (CPITN-3 and CPITN-4) were associated with CKD stages 2 and 3. Thus, periodontal disease may be associated with progression of CKD.

Keywords

Periodontal disease, kidney disease, hypertension, Community Periodontal Index of Treatment Needs, National Kidney Foundation Kidney Disease Outcomes Quality Initiative, epidemiology

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Introduction

Periodontal disease is characterized by the destruction of the connective tissues of the periodontium and alveolar bone. Local symptoms include edema, erythema, gingival enlargement or recession, bleeding, supuration, dental mobility, dental crowding, deep pockets, bone loss, and dental exfoliation. Periodontal disease is associated with systemic cardiovascular pathologies, diabetes, and chronic renal disease. Periodontitis affects 11.2% of the world's population, making it the sixth most common disease in humans.¹ In some regions, the prevalence of periodontal disease is up to 52.5% of the population. Thus, more specialized treatments and greater investment in the treatment of periodontal disease is required.^{2–6}

Chronic kidney disease (CKD), defined as the loss of renal function, is a public health problem related to premature mortality with important social and economic implications. Timely early diagnosis is necessary for appropriate monitoring and interventions.³ CKD presents at various stages ranging from a slight decrease in glomerular function to end-stage chronic renal failure. CKD can be staged according to the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF-KDOQI) guidelines.^{4,5} Recent

studies have indicated that periodontal disease is an important risk factor for various systemic pathologies including diabetes⁶ and CKD. Both the presence and severity of periodontal disease may be associated with CKD.^{7–9} Diabetes may be clinically manifested in the oral cavity through inflammation of the periodontal ligament and gingival bleeding. Furthermore, the presence of periodontal disease is associated with higher risk of morbidity and mortality related to cardiovascular and kidney disease.⁶ Although periodontal disease can result from infection by multiple bacterial species, certain microorganisms such as Gram-negative bacilli have been implicated in the onset and progression of CKD, especially in patients with impaired immunity against bacteria and viruses. Thus, it is important to identify associations between periodontal disease and CKD stage. Epidemiological data have documented a population CKD prevalence of 20.7%; individuals aged 65 years and older are the most affected.³ It is possible that periodontal disease could precede progression of CKD. Thus, it is important to identify high-risk groups in whom progression of CKD could lead to severe sequelae such as renal failure^{10–13} and death.^{14–17} Timely diagnosis of periodontal disease in patients with CKD may inform clinical decision making.

The Community Periodontal Index of Treatment Needs (CPITN) is a periodontal index that evaluates periodontal conditions such as periodontal bleeding, supragingival and subgingival calculus, periodontal pockets 4 to 5 mm, and deep pockets ≥ 6 mm. This study aimed to identify associations between periodontal condition and CKD stage and to determine whether periodontal disease could be used as a predictor of CKD stage.

Methodology

This was a cross-sectional study. Patients were randomly selected from a population diagnosed with periodontal disease and stage 1, 2, and 3 CKD according to the STROBE guidelines.¹⁸ The study was conducted according to the principles outlined in the Declaration of Helsinki, and the study protocol was approved by the Institutional Review Board of the Geriatric Military Hospital, Lima, Perú. All participants provided written informed consent. Patients were categorized into three CKD stages according to the NKF-KDOQI guidelines^{4,5} as follows: CKD stage 1, glomerular filtration rate (GFR) ≥ 90 mL/minute/1.73 m², negative proteinuria, blood pressure 120 to 129 (systolic) and 80 to 84 (diastolic); CKD stage 2, GFR 60 to 89 mL/minute/1.73 m², microalbuminuria, blood pressure 130 to 129 (systolic) and 85 to 89 (diastolic); and CKD stage 3, GFR 30 to 59 mL/minute/1.73 m², proteinuria < 1 g/24 hours, blood pressure 140 to 159 (systolic) and 90 to 99 (diastolic). Participants were aged 65 to 80 years and were of both sexes. Comorbidities included hypertension and diabetes mellitus. We excluded patients with neoplasms and severely compromising systemic conditions.

Periodontal status was assessed using the CPITN. The CPITN is a screening procedure for assessing periodontal status and

treatment needs and is rated on a four-point scale as follows: 1, gingival bleeding after gentle probing of the tooth surfaces; 2, supragingival and subgingival calculus; 3, 4- to 5-mm periodontal deep pockets; and 4, periodontal deep pockets ≥ 6 mm. Clinical data were obtained within a 36-month period. Periodontal status and CKD stage were evaluated in all study participants. Logistic regression analyses were used to calculate odds ratios (ORs) and 95% confidence intervals (CIs).

Results

A total of 1159 patients diagnosed with periodontal disease and CKD were enrolled in the study. The association between CKD stage and CPITN status was stronger in patients aged 73 to 80 years compared with those aged 65 to 72 years (OR 3.74, 95% CI 3.49–3.97, $p < 0.001$). The association between CKD stage and CPITN status did not depend on sex (OR 1.25, 95% CI 0.96–1.67). Among comorbidities, both hypertension (OR 4.78, 95% CI 4.20–5.13, $p < 0.001$) and diabetes mellitus (OR 6.89, 95% CI 6.74–6.96, $p < 0.001$) were associated with stronger CKD stage-CPITN status associations (Table 1).

A total of 722 patients had CKD stage 1. Among patients with CKD stage 1, the ORs (95% CIs) for CPITN-1, CPITN-2, CPITN-3, and CPITN-4 were 1.13 (0.83–1.55), 1.47 (1.13–1.81), 1, and 1, respectively. None of these associations were statistically significant. A total of 288 patients had CKD stage 2. Among patients with CKD stage 2, the ORs (95% CIs) for CPITN-1, CPITN-2, CPITN-3, and CPITN-4 were 1.49 (1.14–1.93), 1.37 (1.02–1.78), 3.07 (2.81–3.25), and 3.65 (3.49–3.71), respectively. All of these associations were statistically significant ($p < 0.05$), with CPITN-3 and CPITN-4 showing the strongest associations. A total of 149 patients had CKD stage 3. Among

Table 1. Characteristics of periodontal disease and CKD in the study population.

Characteristic	n (%)	p-value	PD-CKD association OR (95% CI)
Age (years)		<0.001	
65–72	642 (55.4)		1
73–80	517 (44.6)		3.74 (3.49–3.97)
Sex		>0.05	
Female	625 (53.9)		1
Male	534 (46.1)		1.25 (0.96–1.67)
Hypertension		<0.001	
Yes	876 (75.6)		4.78 (4.20–5.13)
No	283 (24.4)		1
Diabetes mellitus		<0.001	
Yes	752 (64.9)		6.89 (6.74–6.96)
No	407 (35.1)		1

CKD, chronic kidney disease; OR, odds ratio; CI, confidence interval; PD, periodontal disease.

Table 2. Associations between periodontal status (CPITN values) and stages of CKD.

CKD stage	n (%)	CPITN value OR (95% CI)			
		CPITN-1	CPITN-2	CPITN-3	CPITN-4
CKD stage 1	722 (62.3)	1.13 (0.83–1.55)	1.47 (1.13–1.81)	1	1
CKD stage 2	288 (24.8)	1.49 (1.14–1.93)	1.37 (1.02–1.78)	3.07 (2.81–3.25)	3.65 (3.49–3.71)
CKD stage 3	149 (12.9)	1	1	4.61 (4.47–5.21)	5.23 (5.14–5.47)

CKD, chronic kidney disease; OR, odds ratio; CI, confidence interval; CPITN, Community Periodontal Index of Treatment Needs.

patients with CKD stage 3, the ORs (95% CIs) for CPITN-1, CPITN-2, CPITN-3, and CPITN-4 were 1, 1, 4.61 (4.47–5.21), and 5.23 (5.14–5.47), respectively. The associations with CPITN-3 and CPITN-4 were statistically significant ($p < 0.05$) (Table 2).

Discussion

In this study, we analyzed associations between periodontal status and CKD stage in patients aged 65 to 80 years with periodontal disease and CKD. Adults older than 73 years showed a stronger association

between periodontal disease and CDK (OR 3.74, 95% CI 3.49–3.97). Our findings in this study agree with those of other authors,^{11–15} who identified a higher prevalence of periodontal disease in older adults. This situation represents a public health problem and places adults over 65 years of age at a 44% risk of acquiring periodontitis. Periodontitis is a risk factor for CKD. A population of Mexican-Americans with impaired renal function was identified as having twice the risk of periodontal disease compared with healthy individuals.^{16,17} Likewise, in a study conducted in adults

75 years or older in Japan, the authors observed decreased renal function as well as periodontitis.¹¹ It is possible that periodontal disease is a risk factor for the development of CKD. In our study, men had slightly but not statistically significantly stronger associations between periodontal status and CKD stage than women (OR 1.25, 95% CI 0.96–1.67). These findings agree with those of other authors.^{12,14} Our results suggest the presence of conditioning risk factors for CKD. In our study, we observed that patients with hypertension showed stronger associations between periodontal status and CKD (OR 4.78, 95% CI 4.20–5.13). Similarly, patients with diabetes mellitus showed stronger associations between periodontal status and CKD [OR 6.89, 95% CI 6.74–6.96]. According to reports from the World Health Organization, exposures that lead to CKD may be more frequent among older men. In addition, other factors such as family history of diabetes, arterial hypertension, and chronic inflammation may play a role.^{5,6} The most disadvantaged populations would have higher risks of developing CKD (for instance, elderly patients with associated pathologies).^{14–17}

Among patients with CKD stage 1, CPITN-1 (OR 1.13, 95% CI 0.83–1.55) and CPITN-2 (OR 1.47, 95% CI 1.13–1.81) showed non-significant associations with CKD, while CPITN-3 (OR 1) and CPITN-4 (OR 1) showed no association with CKD. Among patients with CKD stage 2, CPITN-1 (OR 1.49, 95% CI 1.14–1.93) and CPITN-2 (OR 1.37, 95% CI 1.02–1.78) showed non-significant associations with CKD. By contrast, CPITN-3 (OR 3.07, 95% CI 2.81–3.25) and CPITN-4 (OR 3.65, 95% CI 3.49–3.71) showed moderate associations with CKD. Among patients with CKD stage 3, CPITN-1 (OR 1) and CPITN-2 (OR 1) showed no association with CKD. By contrast, CPITN-3 (OR 4.61, 95% CI 4.47–5.21) and CPITN-

4 [OR 5.23, 95% CI 5.14–5.47) showed moderate associations with CKD. The CPITN measured periodontal conditions, and attained higher values along with increasing stages of CKD. Our results indicate that the clinical characteristics of periodontal disease may be related to the stage of CKD, and could be used to predict progression of CKD. Studies evaluating the association between periodontal disease and chronic use of corticosteroids in patients with CKD could confirm this association.¹³ Better understanding of these associations would inform clinical management of periodontal disease in patients with CKD.

Epidemiological studies suggest that the highest prevalence of CKD occurs in older adult populations. In this study, older adults were considered a vulnerable group appropriate for evaluating the periodontal disease-CKD association. Comorbid conditions such as diabetes mellitus could influence the progression of periodontal disease. The most common periodontal status among patients with CKD stage 1 was CPITN-1 (bleeding after probing). Most patients with CKD stage 2 had supra-subgingival calculus. In patients with CKD stage 3, many patients had periodontal pockets of 4 to 5 mm and periodontal pockets ≥ 6 mm. Patients with stage 3 CKD had the highest CPITN values, suggesting that periodontal pathology increases in patients with CKD as a function of the time of exposure to the disease. Periodontitis is a risk factor for CKD. Reports indicate that 30% to 60% of the United States population had a high probability of developing moderate periodontitis.^{9,10} According to the results of our study, the association between periodontal disease (CPITN) and the stages of CKD varied by stage. We identified an association between periodontal disease and CKD as described previously by other authors.^{8,14} Thus, periodontal disease may be a risk factor for

decreased renal function.^{15–17} The previous evidence supporting an association between periodontitis and CKD did not provide information regarding the association between periodontal disease and CKD stage. The results of our study showed that in all patients evaluated, the clinical characteristics of periodontal disease were associated with the stages of CKD. These associations may be used to predict CKD progression.

Conclusions

In this study, periodontal disease (CPITN-1 to CPITN-4) and CKD stage (1–3) were evaluated. The highest CPITN values (CPITN-3 and CPITN-4) were associated with CKD stage 2 and CKD stage 3. These results suggest that progression of periodontal disease was associated with more advanced stages of CKD.


Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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