Original Article

Hematological, biochemical, and periodontal alterations at three different stages of chronic kidney disease patients with diabetes: a cross-sectional study

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Background: Chronic kidney disease (CKD) is the leading cause of death. About one in three adults with diabetes also has CKD. The connection between the various stages of chronic renal sickness and periodontal disease (PD) is still up for debate. Thus the present study aims to accomplish the following goals since there is a dearth of information on haematological, biochemical, and periodontal alterations in chronic renal failure patients linked to diabetes.

Methods: The Departments of Periodontology and Oral Pathology at St. Joseph Dental College, Andhra Pradesh, India, created the cross-sectional observational study. A convenience sample of 30 CKD patients with diabetes were enrolled from the Government Medical College's outpatient department in Vijayawada, Andhra Pradesh, India, between January 2019 and June 2019. A blood sample of 3 mL was collected by venipuncture, and evaluated for various hematological, biochemical and periodontal parameters in different stages of CKD patients. One-way Analysis of Variance (ANOVA) was used for multiple group comparisons. The association was considered to be statistically significant if P<0.001.

Results: The mean hemoglobin and pack cell volume (PCV) levels were (10.50, 8.20, 7.10) with P<0.001 and (34.10, 26.00, 19.90) with P<0.001 as the CKD stage progressed from stage 3 to stage 5. The mean creatinine, urea and C-reactive protein (CRP) levels were (4.90, 6.30, 10.40) with P=0.02, (110.00, 83.10, 121.00) with P=0.014 and (23.80, 19.00, 25.60) with P=0.001 as the CKD stage progressed. The mean periodontal parameters like oral hygiene index, gingival index, plaque index, pocket depth, and clinical attachment loss were (2.00, 2.30, 3.20) with P=0.021, (1.40, 1.40, 2.00) with P=0.004, (1.30, 1.20, 2.00) with P<0.001, (5.70, 7.20, 9.90) with P=0.001 and (1.40, 2.30, 3.40) with P<0.001 as the CKD stage progressed from 3 to 5.

Conclusions: The hematological parameters like total white blood cells (WBC) and neutrophils, the biochemical parameters like random blood sugar and creatinine showed a positive association with renal disease severity and higher prevalence of PD seen in CKD patients with diabetes. Thus, the study identified the associations between periodontitis severity and various stages of CKD.

Keywords: Biochemistry; chronic kidney disease (CKD); diabetes; chronic periodontitis; hematology

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Introduction

The impact of periodontal infections on systemic health, both directly and indirectly, is being supported by a growing corpus of research. Studies in the fields of epidemiology, clinical care, and experimental research have demonstrated the frequently underappreciated link between bacteremia, or inflammation brought on by periodontal disease (PD), and systemic illness (1).

The research studies stated that infection from deeper periodontal pockets spreads through the bloodstream to the kidneys and worsen the chronic kidney disease (CKD). Nonetheless, there is still question regarding the relationship between various phases of chronic renal illness and PD (1).

Even though the aetiology and pathophysiology of PD are an interesting issue and have been widely studied, the relationship between PD and many systemic illnesses and conditions is an area of interest to the researchers. The relationship between PD and diabetes mellitus (DM) has received the greatest attention, and periodontitis is the sixth most prevalent among 291 diseases assessed globally (2).

CKD is a serious, irrevocable disorder that results in nephron destruction and impairment of normal renal functioning. DM, hypertension, polycystic kidney disease, and glomerulonephritis are the four most common causes of CKD. CKD, manifests as pathological abnormalities or indicators of the kidney, including abnormalities in the composition of the blood or urine, abnormalities in imaging tests, is described as structural or functional abnormalities of the kidney (3-5).

Highlight box

Key findings

- The hematological parameters like total white blood cells and neutrophils, the biochemical parameters like random blood sugar and creatinine showed a positive association with renal disease severity and higher prevalence of periodontal disease (PD) seen in chronic kidney disease (CKD) patients with diabetes.

What is known and what is new?

- CKD patients with CKD have a higher prevalence and severity of PD.
- Periodontitis risk increases with increased systemic inflammation, as the CKD progress from stage 3 to stage 5.

What is the implication, and what should change now?

- The state of a patient's periodontal health is significantly impacted by CKD severity and thus PD needed to be diagnosed and treated at the earliest.

CKD is defined as either the presence of kidney damage or a decreased kidney function [estimated glomerular filtration rate (eGFR) <60 mL/min/1.73 m^2] for three months or more with different stages of severity. Based on eGFR, mL/min per 1.73 m^2, clinical stages of CKD are classified into stage 0: >90, stage 1: ≥90, stage 2: 60–89, stage 3: 30–59, stage 4: 15–29, and stage 5: <15 (4).

The relationship between PD and CKDs is mainly based on spreading the infection from deeper periodontal pockets through the bloodstream to organs, including the kidney (1). Recent investigations have shown that people with CKD had a higher prevalence and severity of PD (6).

There are numerous risk factors for both periodontitis and CKD, including age, obesity, and smoking. A growing body of evidence shows that renal disease and periodontitis are strongly correlated. Researchers found that PD raised the risk of several chronic diseases. Poor oral hygiene and periodontitis were observed to be much higher in CKD patients. PD has been linked to DM, cardiovascular disease, and other conditions, although its impact on CKD is still up for debate (6,7).

Nearly 60% of CKD patients are previously known to have moderate to severe PD. Malnutrition and PD are linked. In CKD, inflammation and malnutrition are risk factors for morbidity and mortality. According to some views, the enhanced inflammatory response in advanced PD may make CKD worse (8,9).

Hematological markers like hemoglobin, hematocrit (Hct), red blood cell (RBC) count, total leukocyte count (TLC), and platelet count are all out of whack in CKD. These changes result from marrow suppression brought on by uremic products that have been retained and aluminium toxicity brought on by hemodialysis. Biochemical factors including sodium, potassium, calcium, magnesium, and chloride should be kept within physiological range because any deviation from them could be fatal (10,11).

Biochemical parameters such as plasma/serum urea and creatinine are emerging as potential markers for detecting kidney failure as well as monitoring the dose of intermittent hemodialysis. A high level of serum urea and creatinine highlights an increased risk of consequential diseases in CKD patients with periodontitis (11,12).

The purpose of our study was to investigate the association of PD and CKD at various stages by assessing the hematological, biochemical and periodontal parameters. We present this article in accordance with the STROBE reporting checklist (available at https://fomm.amegroups.com/article/view/10.21037/fomm-22-59/rc).

Methods

This cross-sectional observational study was designed in the Department of Periodontology and Oral Pathology Departments at St. Joseph Dental College, Eluru, Andhra Pradesh, India. Patients who attended Outpatient Department of Government Medical College, Vijayawada, Andhra Pradesh, India, from January 2019 to June 2019 were enrolled. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional review board of Saint Joseph Dental College with reference number (No. SJDC/IRB/10/2018-19) and informed consent was taken from all the patients.

Study design and subjects

The study was included thirty patients with CKD. Based on GFR rates, patients were divided into three groups. The sample size was calculated using G Power 3.1 software. At a level of significance set at 5%, power of the study 80% and for an expected effect size of 0.765 (6,9). Hence, we had taken convenience sample of 10 samples each in three groups of CKD patients (6,9).

Selection criteria

Inclusion criteria: study group included CKD patients with diabetes. The age range was restricted to 45–65 years as CKD is more prevalent in those groups.

Exclusion criteria: patients undergoing dialysis treatment. Patients with known cardiovascular diseases and immune deficiency syndrome, hematological disorders or malignancy were excluded. Pregnant and lactating women were excluded from this study. Patient's drug history was taken to exclude if they cause gingival hyperplasia or xerostomia.

Sample collection: all hematological and biochemical analyses took place at Department of Oral Pathology Departments at St. Joseph Dental College, Eluru, Andhra Pradesh, India. 3 mL blood was collected by venipuncture and subjected to hematological and biochemical investigations.

Full blood counts, including total RBC, total white blood cell (WBC), lymphocytes count and percentage, monocyte count and percentage, neutrophil count and percentage, basophil count and percentage, eosinophil count and percentage, hemoglobin, haematocrit, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), MCH concentration (MCHC), red cell distribution width (RDW) and platelets were measured on a Coulter LH 750 haematology analyser.

Biochemical parameters like serum creatinine were measured by the modified Jaffe-Kinetic method. Serum concentration of C-reactive protein (CRP) (Immun Diagnostik AG, Bensheim, Germany) was analyzed using commercially available enzyme linked immunosorbent assay (ELISA) kits according to the manufacturer's protocols. Blood urea nitrogen test, an alkaline phosphatase (ALP) test and lipid profile tests were used to analyze urea, ALP and T cholesterol levels.

Single calibrated periodontist with master's degree and with an experience of 10 years and above in clinical practice performed all the periodontal examination after testing intra-examiner reliability in 10 patients. An intra-class correlation coefficient (ICC) of 0.8 is often considered indicative of good reliability. Periodontal indices oral hygiene index simplified (OHI-S) (Green and Vermilion), Plaque index-PI (Silness and Loe), gingival index (GI) (Loe and Silness), pocket depth, clinical attachment loss were recorded by using University of North Carolina-15 (UNC-15) Probe for the same patients.

Statistical analysis

Statistical software SPSS version 17.0 was used to assess the average values of all measured parameters. Hematological, biochemical, and periodontal data were examined in patient's categorized into stage 3, 4 and stage 5 CKD with diabetes. Data was checked for normal distribution using Shapiro-Wilk test as the data is following normal distribution parametric tests of significance viz, one-way analysis of variance and Tukey's Post Hoc were used.

Results

A cross-sectional observational study was conducted to evaluate and compare the prevalence of PD among stage 3, 4 and 5 CKD patients with diabetes. Out of 30 participants in the he Group I, consists of 10 patients 5 (50%) were female and 5 (50%) were male. Group II, consists of 10 patients 5 (50%) were female and 5 (50%) were male. Group III, consists of 10 patients 5 (50%) were female and 5 (50%) were male. The mean age of the patients was 48.10, 56.66 and 48.66 years of the CKD groups.

Among the evaluated parameters, hemoglobin, pack cell volume (PCV) levels were decreased as the CKD stage progressed, creatinine, urea, and CRP levels elevated as the CKD stage increased statistically as the renal disease progressed. Periodontal parameters are more in CKD stage 5 patients when compared to stage 4 and stage 3.

Hemoglobin values ranged from 7.10 to 10.50 g/dL. As CKD progressed, the hemoglobin decreased. The hemoglobin value was statistically evaluated between stages 3, 4 and 5, which showed the statistically significant value of P=0.006. Even the RBC levels decreased as the disease progressed (*Table 1*).

The usual range of PCV value in an adult is 2.5–97.5; in the present study, PCV% was decreased, indicates RBC loss in patients. As CKD stages progressed, PCV% decreased with P<0.001 (*Table 1* and Table S1).

As the CKD stage advanced, patients revealed a high level of serum creatinine P=0.021 which is within the normal range of 2.7 to 19.5 mg/dL. This increase in serum creatinine was statistically significant and matched the progression of the CKD stages nicely (*Table 2* and Table S2).

Urea levels ranged 83.10 to 121.00 mg/dL, as the kidney disease progressed; there is a rise in urea level. This rise in urea is statistically significant and correlated well with CKD stages with a P=0.014. The CRP value should be lower than 1.0 mg/L; in the present study, CRP values are significantly higher P=0.001; as kidney disease progressed (*Table 2*).

Oral hygiene index, plaque index (3.20, 2.30, 2.00), GI (2.00, 140, 1.40), pocket depth (9.90, 7.20, 5.70), clinical attachment loss (3.40, 2.30, 1.40) are more in CKD stage 5 patients when compared to stage 4 and stage 3 CKD (*Table 3* and Table S3).

Discussion

As the disease progresses, oral manifestations of chronic renal disease are normal and may appear as distinct symptoms of multisystem disorders affecting the kidney. Patients with chronic renal failure are more likely to suffer from periodontal disorders, including gingivitis, severe plaque buildup, and poor oral hygiene. Contradictory findings include periapical lesions and mucosal lesions (12,13).

CKD and PD may be related, according to several cross-sectional studies. PD, which can result in tooth loss, is a chronic inflammatory illness of the tissues around the teeth brought on by the buildup of microorganisms (1,14).

Wasti *et al.* reported reduced RBCs, hemoglobin, and PCV in CKD patients, and similarly, MCH and MCHC indices were also decreased significantly (15). The blood marker for inflammation in the body, CRP, is made in the liver and is categorized as an acute-phase reactant, meaning that its levels will increase in response to inflammation. The finding that CRP levels were raised in CKD patients supports the idea that protein-energy undernutrition and anorexia uremia can lead to elevated CRP levels associated with abnormalities in renal function. CRP levels have shown to be linked with the development of atherosclerosis in CKD patients (16).

The amount of creatinine removed from the body by the kidneys can be calculated to provide a more accurate estimate of renal function. This is known as creatinine clearance, and it calculates the GFR, or the rate of renal filtration (glomerular filtration rate). When evaluating the start and progression of CKD, GFR is frequently utilized as the gold standard for measuring renal function. Due to increased tubular creatinine release, serum creatinine levels rapidly rise when GFR is less than 50% of its typical value (17,18).

Numerous studies show that people with chronic renal failure frequently have inflammation. Due to the fact that PD is an inflammatory condition, the microbial etiologic factors that cause it cause a number of host responses that mediate inflammatory events by dysregulating immunological and inflammatory pathways, causing tissue damage, and illness. According to our findings, an increase in inflammatory mediators triggers the deterioration of the periodontal tissues (19).

In the present study, patients examined showed gingival hyperplasia, increased plaque levels, calculus, gingival inflammation. Higher oral hygiene index scores, plaque index, GI, increased pocket depth, and clinical attachment loss were seen as CKD stage advanced the severity of destructive PDs (20).

Patients with chronic renal failure also had PD, xerostomia, uraemic stomatitis, maxillary and mandibular radiographic changes, and xerostomia. In this study, individuals with advanced CKD had a higher prevalence of periodontal disorders than those with moderate CKD. Markers of inflammation and malnutrition are correlated with poor periodontal health in patients undergoing MHD (21).

Periodontitis results from interactions between particular bacterial species and immune system elements of the host. Systemic inflammation is consequently brought on by periodontitis, which has been demonstrated in prior studies by an elevated level of inflammatory markers in participants with periodontitis. Given that systemic inflammation is

Table 1 Comparison of hematological parameters at various stages of CKD

Parameters	CKD stage	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		P value
						Lower bound	Upper bound	
Age (years)	3	10	48.10	13.295	4.204	38.59	57.61	0.320
	4	10	56.66	17.614	5.570	44.00	69.20	
	5	10	48.66	9.348	2.956	41.91	55.29	
	Total	30	51.10	13.927	2.543	45.90	56.30	
Hemoglobin (g/dL)	3	10	10.50	0.707	0.224	9.99	11.01	0.006
	4	10	8.20	1.033	0.327	7.46	8.94	
	5	10	7.10	1.370	0.433	6.12	8.08	
	Total	30	8.60	1.773	0.324	7.94	9.26	
RBC (m/mm^3)	3	10	4.10	0.316	0.100	3.87	4.33	<0.001
	4	10	3.90	0.316	0.100	3.67	4.13	
	5	10	3.00	0.000	0.000	3.00	3.00	
	Total	30	3.67	0.547	0.100	3.46	3.87	
PCV (%)	3	10	34.10	3.381	1.069	31.68	36.52	<0.001
	4	10	26.00	1.247	0.394	25.11	26.89	
	5	10	19.90	0.568	0.180	19.49	20.31	
	Total	30	26.67	6.255	1.142	24.33	29.00	
TWBC ($thousand/mm^3$)	3	10	7,500.00	1,679.286	531.037	6,298.71	8,701.29	<0.001
	4	10	15,650.00	2,048.983	647.945	14,184.25	17,115.75	
	5	10	9,880.00	588.407	186.070	9,459.08	10,300.92	
	Total	30	11,010.00	3,794.492	692.776	9,593.11	12,426.89	
Neutrophil (%)	3	10	55.30	6.129	1.938	50.92	59.68	<0.001
	4	10	62.80	3.120	0.987	60.57	65.03	
	5	10	75.80	3.393	1.073	73.37	78.23	
	Total	30	64.63	9.615	1.755	61.04	68.22	
Lymphocyte (%)	3	10	36.20	1.398	0.442	35.20	37.20	<0.001
	4	10	29.80	1.229	0.389	28.92	30.68	
	5	10	22.40	2.011	0.636	20.96	23.84	
	Total	30	29.47	5.935	1.084	27.25	31.68	
Eosinophil (%)	3	10	2.50	0.527	0.167	2.12	2.88	<0.001
	4	10	2.80	0.422	0.133	2.50	3.10	
	5	10	2.00	0.000	0.000	2.00	2.00	
	Total	30	2.43	0.504	0.092	2.25	2.62	

Table 1 (*continued*)

Table 1 (*continued*)

Parameters	CKD stage	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		P value
						Lower bound	Upper bound	
Monocyte (%)	3	10	3.00	0.667	0.211	2.52	3.48	<0.001
	4	10	2.40	0.516	0.163	2.03	2.77	
	5	10	2.00	0.000	0.000	2.00	2.00	
	Total	30	2.47	0.629	0.115	2.23	2.70	
Basophils (%)	3	10	0.00	0.000	0.000	0.00	0.00	–
	4	10	0.00	0.000	0.000	0.00	0.00	
	5	10	0.00	0.000	0.000	0.00	0.00	
	Total	30	0.00	0.000	0.000	0.00	0.00	
Platelet (thousand/mm^3)	3	10	1.20	0.632	0.200	0.75	1.65	<0.001
	4	10	2.50	0.527	0.167	2.12	2.88	
	5	10	2.00	0.000	0.000	2.00	2.00	
	Total	30	1.90	0.712	0.130	1.63	2.17	
ESR (mm/h)	3	10	50.00	17.321	5.477	37.61	62.39	<0.001
	4	10	89.90	6.244	1.975	85.43	94.37	
	5	10	73.20	3.910	1.236	70.40	76.00	
	Total	30	71.03	19.669	3.591	63.69	78.38	
MCV (fL)	3	10	76.80	4.638	1.467	73.48	80.12	<0.001
	4	10	63.80	4.315	1.365	60.71	66.89	
	5	10	60.20	3.425	1.083	57.75	62.65	
	Total	30	66.93	8.288	1.513	63.84	70.03	
MCH (pg)	3	10	26.20	1.317	0.416	25.26	27.14	<0.001
	4	10	24.10	0.994	0.314	23.39	24.81	
	5	10	24.30	0.823	0.260	23.71	24.89	
	Total	30	24.87	1.408	0.257	24.34	25.39	
MCHC (g/dL)	3	10	34.20	0.632	0.200	33.75	34.65	<0.001
	4	10	36.10	0.568	0.180	35.69	36.51	
	5	10	35.40	0.516	0.163	35.03	35.77	
	Total	30	35.23	0.971	0.177	34.87	35.60	

CKD, chronic kidney disease; Hb, haemoglobin; RBC, red blood cell; PCV, pack cell volume; TWBC, total white blood cell; ESR, erythrocyte sedimentation rate; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration.

a well-known classical CKD risk factor, a link between periodontitis and CKD is conceivable in this regard (22).

Patients with CKD displayed higher levels of plaque, calculus, gingival inflammation, pocket depth, and higher prevalence and severity of destructive PDs in the current study. Patients with CKD were found to have gingival hyperplasia, which may have been brought on by the calcium channel blockers and calcineurin inhibitors that are

Table 2 Comparison of biochemical parameters at various stages of CKD

Parameters	CKD stage	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		P value
						Lower bound	Upper bound	
RBS (mg/dL)	3	10	408.40	15.371	4.861	397.40	419.40	0.006
	4	10	423.00	57.079	18.050	382.17	463.83	
	5	10	476.30	50.813	16.069	439.95	512.65	
	Total	30	435.90	52.600	9.603	416.26	455.54	
Urea (mmol/L)	3	10	110.00	33.793	10.686	85.83	134.17	0.014
	4	10	83.10	29.095	9.201	62.29	103.91	
	5	10	121.00	17.127	5.416	108.75	133.25	
	Total	30	104.70	31.151	5.687	93.07	116.33	
Creatinine (mg/dL)	3	10	4.90	2.183	0.690	3.34	6.46	0.02
	4	10	6.30	4.968	1.571	2.75	9.85	
	5	10	10.40	5.060	1.600	6.78	14.02	
	Total	30	7.20	4.766	0.870	5.42	8.98	
T cholesterol (mg/dL)	3	10	218.10	24.763	7.831	200.39	235.81	<0.001
	4	10	163.30	15.663	4.953	152.10	174.50	
	5	10	203.10	3.635	1.149	200.50	205.70	
	Total	30	194.83	28.699	5.240	184.12	205.55	
ALP (U/L)	3	10	79.10	10.038	3.174	71.92	86.28	<0.001
	4	10	101.50	11.975	3.787	92.93	110.07	
	5	10	83.60	5.016	1.586	80.01	87.19	
	Total	30	88.07	13.432	2.452	83.05	93.08	
CRP (mg/dL)	3	10	23.80	2.098	0.663	22.30	25.30	0.001
	4	10	19.00	3.399	1.075	16.57	21.43	
	5	10	25.60	4.766	1.507	22.19	29.01	
	Total	30	22.80	4.475	0.817	21.13	24.47	
GFR (mL/min)	3	10	23.10	10.898	3.446	15.30	30.90	0.002
	4	10	16.70	4.923	1.557	13.18	20.22	
	5	10	10.30	3.057	0.967	8.11	12.49	
	Total	30	16.70	8.691	1.587	13.45	19.95	

CKD, chronic kidney disease; RBS, random blood sugar; ALP, alkaline phosphatase; CRP, C-reactive protein; GFR, glomerular filtration rate.

frequently used to treat renal illness. Patients with CKD experience platelet failure and the effects of anticoagulants, which lead to gingival bleeding, petechiae, and ecchymosis. Systemic strain can also lead to periodontal issues such attachment loss, recession, and deep pockets (23).

Kidney failure and CKD are most frequently brought on by DM, a disease that is on the rise. One of the most prevalent consequences of diabetes is diabetic nephropathy, which affects 20–40% of people with the disease. Nephropathy should be checked on all diabetic patients

Table 3 Comparison of periodontal parameters at various stages of CKD

Parameters	CKD stage	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		P value
						Lower bound	Upper bound	
OHI	3	10	2.00	1.414	0.447	0.99	3.01	0.021
	4	10	2.30	0.675	0.213	1.82	2.78	
	5	110	3.20	0.422	0.133	2.90	3.50	
	Total	30	2.50	1.042	0.190	2.11	2.89	
Plaque index	3	10	1.30	0.483	0.153	0.95	1.65	<0.001
	4	10	1.20	0.422	0.133	0.90	1.50	
	5	10	2.00	0.000	0.000	2.00	2.00	
	Total	30	1.50	0.509	0.093	1.31	1.69	
Gingival index	3	10	1.40	0.516	0.163	1.03	1.77	0.004
	4	10	1.40	0.516	0.163	1.03	1.77	
	5	10	2.00	0.000	0.000	2.00	2.00	
	Total	30	1.60	0.498	0.091	1.41	1.79	
Pockets (mm)	3	10	5.70	3.093	0.978	3.49	7.91	0.001
	4	10	7.20	1.814	0.573	5.90	8.50	
	5	10	9.90	0.738	0.233	9.37	10.43	
	Total	30	7.60	2.699	0.493	6.59	8.61	
Mean pockets (mm)	3	10	4.10	0.316	0.100	3.87	4.33	<0.001
	4	10	5.30	0.675	0.213	4.82	5.78	
	5	10	6.00	0.471	0.149	5.66	6.34	
	Total	30	5.13	0.937	0.171	4.78	5.48	
CAL (mm)	3	10	1.40	0.516	0.163	1.03	1.77	<0.001
	4	10	2.30	0.675	0.213	1.82	2.78	
	5	10	3.40	0.516	0.163	3.03	3.77	
	Total	30	2.37	0.999	0.182	1.99	2.74	

CKD, chronic kidney disease; OHI, oral hygiene index; CAL, clinical attachment loss.

annually. Since the onset of diabetes itself is typically recognized, screening for nephropathy in people with type 1 diabetes should begin five years following diagnosis. Microvascular problems often take five years to develop. Since the precise time of the onset of diabetes is frequently uncertain in patients with type 2 diabetes, screening should start at the time of initial diagnosis (24).

Limitations of the study

The outcome of this research in one location and a small number of participants enrolled while still comparable to most other reports are two of its drawbacks. We were unable to take into account the socioeconomic circumstances and educational achievements of these participants, which might have an impact on their oral health (25,26).

Conclusions

The biochemical markers such as random blood sugar and creatinine, as well as the haematological parameters total WBCs and neutrophils, all revealed a positive correlation

with the severity of renal disease and a higher prevalence of PD in CKD patients with diabetes. Patients with CKD are advised to have regular dental checkups and receive appropriate preventive dental treatment, especially in the early stages of the disease. It is necessary to link the relationship between CKD and severe periodontitis and mortality to confirm the desired survival outcome following effective PD therapy in a prospective cohort research.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://fomm.amegroups.com/article/view/10.21037/fomm-22-59/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional review board of Saint Joseph Dental College with reference number (No. SJDC/IRB/10/2018-19) and informed consent was taken from all the patients.

References

1. Palmeira E, de Liz Pérez-Losada F, Díaz-Flores-García V, et al. Prevalence of oral infections in chronic kidney disease patients: A cross-sectional study. Oral Dis. 2023. [Epub shead of print]. doi:10.1111/odi.14663
2. Genco RJ, Borgnakke WS. Diabetes as a potential risk for periodontitis: association studies. Periodontol 2000 2020;83:40-5.
3. Jain A, Kabi D. Severe periodontitis associated with chronic kidney disease. J Indian Soc Periodontol 2013;17:128-30.
4. Afshar R, Sanavi S, Salimi J, et al. Hematological profile of chronic kidney disease (CKD) patients in Iran, in pre-dialysis stages and after initiation of hemodialysis. Saudi J Kidney Dis Transpl 2010;21:368-71.
5. Ausavarungnirun R, Wisetsin S, Rongkiettechakorn N, et al. Association of dental and periodontal disease with chronic kidney disease in patients of a single, tertiary care centre in Thailand. BMJ Open 2016;6:e011836.
6. Munagala KK, Nanda S, Chowdhary Z, et al. Severity of Periodontal Disease in Chronic Kidney Disease Patients: A Hospital-Based Study. Cureus 2022;14:e25646.
7. Ricardo AC, Athavale A, Chen J, et al. Periodontal disease, chronic kidney disease and mortality: results from the third National Health and Nutrition Examination Survey. BMC Nephrol 2015;16:97.
8. Kapellas K, Singh A, Bertotti M, et al. Periodontal and chronic kidney disease association: A systematic review and meta-analysis. Nephrology (Carlton) 2019;24:202-12.
9. Kopić V, Barbić J, Petrović S, et al. Periodontal disease in different stages of chronic kidney disease. Acta Clin Croat 2019;58:709-15.
10. Finkelstein FO, Story K, Firanek C, et al. Health-related quality of life and hemoglobin levels in chronic kidney disease patients. Clin J Am Soc Nephrol 2009;4:33-8.
11. Miyata Y, Obata Y, Mochizuki Y, et al. Periodontal Disease in Patients Receiving Dialysis. Int J Mol Sci 2019;20:3805.
12. George C, Matsha TE, Erasmus RT, et al. Haematological profile of chronic kidney disease in a mixed-ancestry South African population: a cross-sectional study. BMJ Open 2018;8:e025694.

13. Kshirsagar AV, Moss KL, Elter JR, et al. Periodontal disease is associated with renal insufficiency in the Atherosclerosis Risk In Communities (ARIC) study. Am J Kidney Dis 2005;45:650-7.
14. Grubbs V, Garcia F, Vittinghoff E, et al. Nonsurgical Periodontal Therapy in CKD: Findings of the Kidney and Periodontal Disease (KAPD) Pilot Randomized Controlled Trial. Kidney Med 2020;2:49-58.
15. Wasti AZ, Iqbal S, Fatima N, et al. Hematological disturbances associated with chronic kidney disease and kidney transplant patients. Int J Adv Res 2013;1:48-54.
16. Abraham G, Sundaram V, Sundaram V, et al. C-Reactive protein, a valuable predictive marker in chronic kidney disease. Saudi J Kidney Dis Transpl 2009;20:811-5.
17. Ruospo M, Palmer SC, Craig JC, et al. Prevalence and severity of oral disease in adults with chronic kidney disease: a systematic review of observational studies. Nephrol Dial Transplant 2014;29:364-75.
18. Summers SA, Tilakaratne WM, Fortune F, et al. Renal disease and the mouth. Am J Med 2007;120:568-73.
19. Costacurta M, Basilicata M, Marrone G, et al. The Impact of Chronic Kidney Disease on Nutritional Status and Its Possible Relation with Oral Diseases. Nutrients 2022;14:2002.
20. Artese HP, Sousa CO, Luiz RR, et al. Effect of non-surgical periodontal treatment on chronic kidney disease patients. Braz Oral Res 2010;24:449-54.
21. Li L, Zhang YL, Liu XY, et al. Periodontitis Exacerbates and Promotes the Progression of Chronic Kidney Disease Through Oral Flora, Cytokines, and Oxidative Stress. Front Microbiol 2021;12:656372.
22. Kshirsagar AV, Grubbs V. Periodontal Disease and CKD-Associated Morbidity: Is There Now Enough Evidence to Move From Observation to Intervention? Am J Kidney Dis 2015;66:181-3.
23. Delbove T, Gueyffier F, Juillard L, et al. Effect of periodontal treatment on the glomerular filtration rate, reduction of inflammatory markers and mortality in patients with chronic kidney disease: A systematic review. PLoS One 2021;16:e0245619.
24. Hahr AJ, Molitch ME. Management of diabetes mellitus in patients with chronic kidney disease. Clin Diabetes Endocrinol 2015;1:2.
25. Serni L, Caroti L, Barbato L, et al. Association between chronic kidney disease and periodontitis. A systematic review and metanalysis. Oral Dis 2023;29:40-50.
26. Chen LP, Chiang CK, Chan CP, et al. Does periodontitis reflect inflammation and malnutrition status in hemodialysis patients? Am J Kidney Dis 2006;47:815-22.

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Supplementary

Table S1 Hematological parameters in patients with 3rd 4th and end stage of CKD

Sample No.	CKD	Age, years	Hb (g/dL)	RBC (m/mm^3)	PCV (%)	TWBC (thousand/mm^3)	Neutrophil, %	Lymphocyte, %	Eosinophil, %	Monocyte, %	Basophils, %	Platelet count (thousand/mm^3)	ESR (mm/h)	MCV (fL)	MCH (pg)	MCHC (g/dL)
1	3	61	10.9	4.4	32.4	7,700	50	35	3	3	0	1.4	30	74	25.1	33.8
2	3	30	11.1	3.9	32.2	5,000	58	36	2	4	0	1.1	40	82	28.2	34.5
3	3	50	10.4	4.4	38.7	8,000	53	38	2	3	0	1.21	45	77	26.2	34
4	3	61	10.9	4.4	32.4	7,700	50	35	3	3	0	1.11	40	76	25.1	33.8
5	3	30	11.1	3.9	32.2	6,000	58	36	3	3	0	1.1	55	82	28.2	34.5
6	3	50	10.4	5	38.7	9,000	53	37	2	2	0	1.21	50	77	26.2	34
7	3	61	10.9	4.4	32.4	7,700	50	35	3	2	0	1.2	50	74	25.1	33.8
8	3	30	11.1	3.9	32.2	5,000	58	36	2	4	0	1.1	50	82	28.2	34.5
9	3	50	10.4	4.4	38.7	9,000	53	39	2	3	0	1.21	45	77	26.2	34
10	3	58	9.1	3.7	31.7	9,900	70	35	3	3	0	2.55	95	67	25	36.1
11	4	40	8.3	3.8	26.1	15,100	60	29	2	3	0	2.56	90	66	24.4	36.8
12	4	80	8.6	3.8	25.4	15,500	66	31	3	2	0	2.43	89	68	25	35.7
13	4	58	9.1	4	24.7	17,900	60	30	3	2	0	2.55	100	67	24	36.1
14	4	40	8.3	4	26.1	15,100	60	29	2	2	0	2.46	80	61	23.4	36.8
15	4	80	8.6	3.8	25.4	12,500	66	28	3	3	0	2.23	90	66	23.6	35.7
16	4	58	9.1	3.9	25.7	17,900	60	29	3	2	0	2.55	95	67	23	36.1
17	4	40	8.3	3.9	26.1	15,100	60	29	3	3	0	2.66	90	65	23.4	35.8
18	4	80	8.6	3.9	25.4	12,500	66	30	3	2	0	2.63	90	64	24.6	35.7
19	4	50	6.9	3.9	26.8	17,000	63	31	3	2	0	2.29	95	60	24.3	36.2
20	4	40	6.4	3	28.6	17,900	67	32	3	3	0	2.08	80	54	25.9	34.9
21	5	41	6.5	3	19.9	10,200	78	25	2	2	0	2.01	70	61	24.4	34.8
22	5	61	9.3	3.1	20.3	9,800	78	26	2	2	0	1.88	79	61	24.8	34.6
23	5	50	6.9	3.1	19.8	9,000	73	23	2	2	0	2.09	75	60	24.3	35.2
24	5	40	6.4	3	18.6	8,900	77	22	2	2	0	2.18	70	64	24.9	34.9
25	5	41	6.5	2.9	19.9	10,200	68	20	2	2	0	2.01	80	61	23.4	35.8
26	5	61	9.3	3.1	20.3	9,800	78	21	2	2	0	1.88	70	65	24.8	35.6
27	5	50	6.9	3.2	20.8	10,000	73	23	2	2	0	1.99	75	60	25.3	35.2
28	5	40	6.4	3	18.6	10,900	77	21	2	2	0	2.18	70	54	24.9	34.9
29	5	41	6.5	3.1	19.9	10,200	78	20	2	2	0	2.01	73	61	23.4	35.8
30	5	61	9.3	3.2	20.4	9,800	78	23	2	2	0	1.98	70	55	23.8	35.6

CKD, chronic kidney disease; Hb, hemoglobin; RBC, red blood cell; PCV, pack cell volume; TWBC, total white blood cell; ESR, erythrocyte sedimentation rate; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration.

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Table S2 Biochemical parameters in patients with 3rd, 4th and end stage of CKD

Sample No.	CKD	Age, years	RBS (mg/dL)	Urea (mmol/L)	Creatinine (mg/dL)	T cholesterol (mg/dL)	ALP (U/L)	CRP (mg/dL)	GFR (mL/min)
1	3	61	388	141	2.7	238	70	23.63	31.76
2	3	30	410	63	4.5	220	77	25.99	30.3
3	3	50	420	126	7.8	218	78	22.89	8.1
4	3	61	388	141	2.7	228	80	23.63	31.76
5	3	30	410	63	4.5	217	77	25.99	30.3
6	3	50	420	126	7.8	223	78	22.89	8.1
7	3	61	388	141	2.7	228	70	23.63	31.76
8	3	30	410	63	4.5	230	77	25.99	30.3
9	3	50	420	126	7.8	229	78	22.89	8.1
10	3	58	430	110	4	150	106	18.51	21
11	4	40	430	63	3.9	154	102	19.95	16.1
12	4	80	366	59	4.7	159	103	15.28	20.11
13	4	58	430	110	4	160	106	18.51	21
14	4	40	430	63	3.9	164	102	19.95	16.1
15	4	80	366	59	4.7	159	103	15.28	20.11
16	4	58	430	110	4	160	106	18.51	21
17	4	40	430	63	3.9	154	102	19.95	16.1
18	4	80	366	59	4.7	169	113	15.28	20.11
19	4	50	562	115	7.5	149	109	20.75	10.83
20	4	40	420	130	19.5	205	69	25.88	6.2
21	5	41	450	100	7.9	200	75	21.63	13.5
22	5	61	483	140	8	201	80	32.49	9.12
23	5	50	562	115	7.5	209	79	20.75	10.83
24	5	40	420	130	19.5	205	79	25.88	6.2
25	5	41	450	100	7.9	200	85	21.63	13.5
26	5	61	483	140	8	201	89	32.49	9.12
27	5	50	562	115	7.5	209	89	20.75	10.83
28	5	40	420	130	19.5	205	86	25.88	6.2
29	5	41	450	100	7.9	200	85	21.63	13.5
30	5	61	483	140	8	201	89	32.49	9.12

CKD, chronic kidney disease; RBS, Random blood sugar; ALP, alkaline phosphatase; CRP, C-reactive protein; GFR, glomerular filtration rate.

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Table S3 Periodontal parameters in patients with 3rd, 4th and end stage of CKD

Sample No.	CKD	Age, years	OHI	Plaque index	Gingival index	No pockets (mm)	Mean pockets (mm)	CAL
1	3	61	1.2	1.2	1.3	3	4.3	1.3
2	3	30	1.2	1.2	1.2	4	4.5	1.5
3	3	50	3.6	2.1	2.14	10	4.1	1.3
4	3	61	1.2	1.2	1.3	3	4.3	1.3
5	3	30	1.2	1.2	1.2	4	4.5	1.5
6	3	50	3.6	2.1	2.14	10	4.1	1.3
7	3	61	1.2	1.2	1.3	3	4.3	1.3
8	3	30	1.2	1.2	1.2	4	4.5	1.5
9	3	50	3.6	2.1	2.14	10	4.1	1.3
10	3	58	2.5	1	1.8	6	5.1	2.1
11	4	40	2.3	1.4	1.3	7	4.8	1.8
12	4	80	2.3	1.3	1.3	6	5	2
13	4	58	2.5	1	1.8	6	5.1	2.1
14	4	40	2.3	1.4	1.3	7	5.4	1.8
15	4	80	2.3	1.3	1.3	6	5	2
16	4	58	2.5	1	1.8	6	5.1	2.1
17	4	40	2.3	1.4	1.3	7	4.8	2
18	4	80	2.3	1.3	1.3	6	5	2
19	4	50	3.4	2.1	2.38	11	5.5	2.7
20	4	40	3.6	2	2.32	10	6.6	3.8
21	5	41	3.4	2	2.16	10	6.3	3.2
22	5	61	3.2	1.6	2.2	9	6.3	3.4
23	5	50	3.4	2.1	2.38	11	6.5	3.7
24	5	40	3.6	2	2.32	10	6.6	3.8
25	5	41	3.4	2	2.16	10	6.3	3.2
26	5	61	3.2	1.6	2.2	9	5.3	3.4
27	5	50	3.4	2.1	2.38	11	6.5	3.7
28	5	40	3.6	2	2.32	10	5.6	3.8
29	5	41	3.4	2	2.16	10	6.3	3.2
30	5	61	3.2	1.6	2.2	9	6.3	3.4

CKD, chronic kidney disease; OHI, Oral Hygiene Index; CAL, clinical attachment loss.

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