

Original Research Article

Assessment of oral health in chronic kidney disease patients aged between 30-70 years in Mangalore, South India

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ABSTRACT

Background: Chronic kidney disease (CKD) is an increasing health concern worldwide. In addition to systemic changes, kidney disease patients also present with oral complications. The objectives of the study were to assess and compare the oral health status in patients with CKD (with diabetes and without diabetes) undergoing dialysis and not undergoing dialysis aged between (30-70) years and controls in Mangalore, South India.

Methods: A descriptive cross-sectional study was conducted among 160 adults with various types of kidney disease and controls, attending a tertiary care hospital in Mangalore. Oral health status was assessed using WHO oral health assessment form for adults 2013. Oral hygiene was assessed by using simplified oral hygiene index and gingival status was assessed by using modified gingival index.

Results: Number of decayed teeth was more among controls, and number of missing teeth was more among CKD patients. Diabetic CKD patients who were not on dialysis had highest number of teeth with periodontal pocket and more sextants with loss of attachment. Non-diabetic CKD patients who were on dialysis had more gingival bleeding and gingival inflammation. Multinomial logistic regression analysis showed that CKD patients have more odds of having poor oral health than controls.

Conclusions: CKD patients had poor oral hygiene, gingival and periodontal status. In contrast, dental caries was significantly lower in CKD patients than the control group. Good oral health condition mitigates the risk of infection, contributing to a better quality of life among CKD patients.

Keywords: Kidney disease, Oral health, Diabetes mellitus, Dialysis, Quality of life

INTRODUCTION

Oral health is a significant predictor of general health, well-being and quality of life.¹ The World Oral Health report (2003) affirmed that, evidence supports the association between oral health and general health. Oral health and general health are linked to each other mainly in four ways: most of the times poor oral health is related to major chronic diseases, poor oral health lead to disability, oral health issues and major diseases share

several common risk factors, and general health problems can cause or aggravate oral health conditions.²

Of all the systemic disorders worldwide, diseases of the renal system are a major cause of morbidity and mortality, as kidneys are essential organs to maintain a healthy internal environment i.e. homeostasis. India is now becoming a major reservoir of chronic diseases like diabetes and hypertension. This burden is likely to increase and thus, health care professionals have to take care of it, as 25 to 40 percent of these individuals may

develop chronic kidney disease (CKD) and end stage renal disease (ESRD).³

Diseases causing chronic renal failure are numerous, but the most significant and common cause is diabetes mellitus.⁴ According to WHO report, the number of people with diabetes has increased from 108 million in 1980 to 422 million in 2014.⁵ Other important etiologies of CKD are hypertension, chronic glomerulonephritis (CGN), systemic autoimmune diseases, atherosclerotic renovascular disease, polycystic kidney disease (PKD), obstructive uropathy, and chronic pyelonephritis.⁶ Many systemic rheumatologic diseases and infections cause persistent inflammation that may also contribute to CKD.⁷

About 60,000 persons annually lose their lives due to kidney related diseases.⁸ CKD is the 12th leading cause of death and 17th leading cause of disability in the world.³

In addition to increasing prevalence, CKD is associated with significantly reduced quality of life, sexual dysfunction, unemployment, depression, and premature mortality.⁹ Due to their rising prevalence and economic effects on public health care, CKDs are a growing health problem worldwide.⁷

In addition to systemic changes, renal disease patients on renal therapy may also have oral complications due to general state of disability, depression of the immunologic response and masking of signs and symptoms by drug therapy.¹⁰ Oral cavity is considered as the mirror of systemic health. Oral disease represents a potential and preventable cause of impaired health in people with CKD.⁹ Oral symptoms are found in 90 percent of renal patients, as the disorder itself and its treatment have systemic and oro-dental manifestations.¹¹ These include gingival inflammation, gingival enlargement and attachment loss, alterations in salivary composition, reduced salivary flow rate, adverse effects related to drug therapy, mucosal lesions, oral malignancies, oral infections, dental anomalies, bone lesions, loss of lamina dura, bony fractures, bone tumors, loosening of teeth and malocclusions. In addition, there have also been reports of increased dental calculus and lower caries rate, which may be due to elevated levels of salivary urea and phosphate in these patients.¹⁰ Poor oral hygiene and increased plaque and gingival inflammation have been linked to inadequate oral care in patients suffering from ESRD.¹² Chronic disease is especially associated with poorer oral health and greater unmet dental need, including untreated dental disease, self-reported poor oral health, and tooth loss.⁹

Calcium channel blockers and calcineurin inhibitors, widely used in the treatment of renal disease can cause gingival hyperplasia in patients with CKD. Gingival overgrowth caused by these drugs may be severe, involving the interdental papilla, marginal and attached gingiva and sometimes may require even surgical

resection. However, it has been stated that improved oral hygiene can either reduce the incidence or postpone the occurrence of gingival hyperplasia. Gingival bleeding, petechiae and ecchymosis, result from platelet dysfunction and due to the effects of anticoagulants in CKD patients. Periodontal issues can also arise with attachment loss, recession and deep pockets.³

Periodontitis is a bacteria-induced infection of tooth supporting tissues that induces not only local but also low-grade systemic inflammation, which has also been proposed as a risk factor for CKD.⁷ Medical treatment procedures in these patients may be delayed due to the unsatisfactory oral health status and the possible risk of post-operative infection, which may be life threatening.¹¹

A thorough examination of the oral cavity in CKD patients is indispensable for diagnosis at an early stage of multi-system illness. Therefore, such patients should be regularly examined for oral diseases and treated accordingly. The dental management of renal disease patients is complicated by systemic consequences of renal failure especially anemia, bleeding tendency, cardiovascular or endocrine diseases, but the dental management of these patients can be successful and safe by using proper treatment protocols. A simple routine examination of the oral cavity should become the norm for all physicians caring for renal patients.

Although many studies have evaluated oral manifestations in individuals with CKD, the results of those studies are quite contrasting. Also, a review of scientific literature showed no study that assessed and compared the oral health status in patients with various types of kidney disease like chronic kidney disease (with diabetes and without diabetes) undergoing dialysis and not undergoing dialysis. This necessitates the present study to assess and compare the oral health status in patients with chronic kidney disease (with diabetes and without diabetes) undergoing dialysis and not undergoing dialysis and to find out how various types of renal disease alter oral health.

METHODS

A descriptive cross-sectional study was conducted from December 2018 to September 2019 to assess oral health in patients with CKD and controls aged between 30-70 years. The study was conducted in Yenepoya Medical College Hospital in Mangalore, Karnataka. Ethical clearance for the study was obtained from the institutional ethics committee. Study participants comprised 160 adults with various types of CKD and controls. The estimated sample size was 160 with a level of significance 5% and power 80%. Study participants were selected using convenience sampling.

Patients aged between 30-70 years attending Yenepoya Medical College Hospital in Mangalore, diagnosed with CKD at least two years back were included in the study.

The CKD patients were divided into 4 groups. CKD patients not undergoing dialysis and without diabetes, CKD patients not undergoing dialysis and with diabetes, CKD patients undergoing dialysis and without diabetes, and CKD patients undergoing dialysis and with diabetes. Patient companions aged between 30-70 years who are not on chronic medication and with no chronic systemic disease were taken as controls. Uncooperative individuals or individuals who did not consent to participate in the study were excluded. Written informed consent was obtained from all the participants.

The clinical examination of all the study participants was done by a trained single examiner with the help of a recorder. Prior to the study, the examiner was trained to record the oral health status according to WHO oral health assessment for adults 2013.¹³ The following information was recorded using the oral health assessment form: general information, extra-oral conditions, dentition status (crown, root), periodontal status, loss of attachment, enamel fluorosis, dental erosion, dental trauma, oral mucosal lesions, denture status and Intervention urgency and need for referral.

The oral hygiene was assessed by using simplified oral hygiene index (OHI-S) given by Greene and Vermillion in 1964.¹⁴ A score of 0.0-1.2 was considered good oral hygiene, 1.2-3.0 as fair oral hygiene and 3.1-6.0 as poor oral hygiene. Higher scores indicated poorer oral hygiene.

The gingival status was assessed by using modified gingival index by Lobene in 1986.¹⁵ A score of 0.1-1.0 was considered mild inflammation, 1.1-2.0 as moderate inflammation and 2.1-3.0 as severe inflammation. Higher scores indicated increased gingival inflammation.

Statistical tests were done using SPSS version 23. Decayed missing filled teeth (DMFT), gingival bleeding, periodontal pocket and loss of attachment which are continuous variables are expressed in terms of mean and standard deviation. Categorical variables such as gender and age are expressed in terms of frequencies and

percentages. To compare the variables between the groups, Chi-square test, independent t test and ANOVA were used, and post hoc analysis (Bonferoni) was done. Multinomial logistic regression analysis was used to find the relationship between chronic kidney disease and oral health status. The level of significance was set at $p < 0.05$.

RESULTS

A total of 160 participants, 40 chronic kidney disease patients not undergoing dialysis and without diabetes, 40 chronic kidney disease patients not undergoing dialysis and with diabetes, 22 chronic kidney disease patients undergoing dialysis and without diabetes, 18 chronic kidney disease patients undergoing dialysis and with diabetes, and 40 controls participated in the study.

Among the participants, 97 were males and 63 were females, 60 participants were in the age group of 30-40 years, 41 were in the age group of 41-50 years, 37 were in the age group of 51-60 years and 22 participants were in the age group of 61-70 years (Table 1).

Table 2 shows the mean DMFT scores of CKD patients and controls. There was a statistically significant difference in the mean number of decayed teeth ($p = 0.033$) and mean number of missing teeth ($p = 0.013$) between controls and CKD patients. The number of decayed teeth was more among the controls, and number of missing teeth was more among the CKD patients. The total DMFT score was more in CKD patients. But it was not statistically significant ($p = 0.418$). And also, there was no significant difference in DMFT score between the different types of CKD patients.

There was no significant difference in the presence of gingival bleeding between controls and CKD patients. But there was a statistically significant difference in the presence of gingival bleeding between the different types of CKD patients ($p < 0.001$), with non-diabetic CKD patients who were on dialysis having highest number of teeth with gingival bleeding (Table 3).

Table 1: Distribution of study participants by gender and age.

Demographic characteristic	CKD patients				Control	Total	X ²	P value
	No dialysis and no diabetes	No dialysis and diabetes	Dialysis and no diabetes	Dialysis and diabetes				
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)		
Gender								
Male	22 (22.7)	31 (32.0)	10 (10.3)	13 (13.4)	21 (21.6)	97 (100.0)	9.543	0.049
Female	18 (28.6)	9 (14.3)	12 (19.0)	5 (7.9)	19 (30.2)	63 (100.0)		
Age (years)								
30-40	17 (28.3)	10 (16.7)	7 (11.7)	3 (5.0)	23 (38.3)	60 (100.0)		
41-50	12 (29.3)	13 (31.7)	5 (12.2)	6 (14.6)	5 (12.2)	41 (100.0)	16.185	0.183
51-60	7 (18.9)	11 (29.7)	6 (16.2)	5 (13.5)	8 (21.6)	37 (100.0)		
61-70	4 (18.2)	6 (27.3)	4 (18.2)	4 (18.2)	4 (18.2)	22 (100.0)		

X²- chi square test, $p < 0.05$ statistically significant.

Table 2: Mean DMFT scores among chronic renal disease patients and controls.

Group	N	Mean	Standard deviation	t value	P value
Decayed					
Control	40	2.73	3.21	2.19	0.033
Chronic renal disease	120	1.53	2.15		
Missing					
Control	40	2.50	3.40	-2.53	0.013
Chronic renal disease	120	4.83	8.19		
Filled					
Control	40	0.40	0.98	1.45	0.154
Chronic renal disease	120	0.16	0.67		
DMFT					
Control	40	5.63	4.99	-0.81	0.418
Chronic renal disease	120	6.52	8.35		

t- Independent t test, $p < 0.05$ statistically significant.

Table 3: Mean number of teeth with gingival bleeding among different types of chronic renal disease.

Group	N	Mean	Standard deviation	F value	P value
Absence of gingival bleeding					
No dialysis and no diabetes	40	14.95	14.87	4.99	0.003
No dialysis and diabetes	40	20.05	11.36		
Dialysis and no diabetes	22	7.23	9.83		
Dialysis and diabetes	18	13.28	13.16		
Presence of gingival bleeding					
No dialysis and no diabetes	40	12.88	14.62	10.08	0.000
No dialysis and diabetes	40	4.88	8.51		
Dialysis and no diabetes	22	22.23	11.69		
Dialysis and diabetes	18	14.78	13.75		

F- ANOVA test, $p < 0.05$ statistically significant.

Table 4: Mean number of teeth with periodontal pocket and mean number of sextants with loss of attachment among chronic kidney disease patients and controls.

Group	N	Mean	Standard deviation	t value	P value
Periodontal pocket (4-5 mm)					
Control	40	2.80	8.18	-1.72	0.088
Chronic renal disease	120	5.31	7.95		
Periodontal pocket (6 mm or more)					
Control	40	0.40	1.78	-2.09	0.038
Chronic renal disease	120	1.53	3.23		
Loss of attachment (4-5 mm)					
Control	40	0.98	1.95	-1.00	0.317
Chronic renal disease	120	1.31	1.77		
Loss of attachment (6-8 mm)					
Control	40	0.15	0.66	-3.92	0.000
Chronic renal disease	120	0.80	1.41		

t- Independent t test, $p < 0.05$ statistically significant.

As shown in Table 4, there was significant difference in mean number of teeth with periodontal pocket and mean number of sextants with loss of attachment, with CKD patients having a greater number of teeth with periodontal pocket and more sextants with loss of attachment than controls. On comparison between the CKD patients, it was found that diabetic CKD patients who were not on

dialysis had highest number of teeth with periodontal pocket and more sextants with loss of attachment.

Assessment of simplified oral hygiene index ($p=0.019$) and modified gingival index ($p=0.012$) showed significantly higher mean score among CKD patients than controls (Table 5).

Table 5: Mean score of simplified oral hygiene index and modified gingival index among chronic renal disease patients and controls.

Group	N	Mean	Standard deviation	t value	P value
Simplified oral hygiene index					
Control	40	2.22	1.29	-2.38	0.019
Chronic renal disease	120	2.74	1.16		
Modified gingival index					
Control	40	1.31	0.84	-2.60	0.012
Chronic renal disease	120	1.69	0.69		

t- Independent t test, p<0.05 statistically significant.

Table 6: Mean score of simplified oral hygiene index and modified gingival index among different types of chronic renal disease.

Group	N	Mean	Standard deviation	F value	P value
Simplified oral hygiene index					
No dialysis and no diabetes	40	2.96	1.34	0.86	0.463
No dialysis and diabetes	40	2.58	1.03		
Dialysis and no diabetes	22	2.57	1.04		
Dialysis and diabetes	18	2.82	1.18		
Modified gingival index					
No dialysis and no diabetes	40	1.78	0.62	2.82	0.042
No dialysis and diabetes	40	1.51	0.69		
Dialysis and no diabetes	22	1.99	0.61		
Dialysis and diabetes	18	1.54	0.81		

F- ANOVA test, p<0.05 statistically significant.

Table 7: Logistic regression analysis to determine the effect of chronic kidney disease on oral health status.

Oral health	Groups	B	SE	Wald	df	P value	Odds ratio	95% confidence interval for odds ratio	
								Lower	Upper
DMFT ≥1	Control	Ref							
	CKD	0.13	0.41	0.10	1	0.754	1.14	0.51	2.55
Gingival bleeding present	Control	Ref							
	CKD	0.20	0.37	0.30	1	0.583	1.22	0.60	2.50
Periodontal pocket present	Control	Ref							
	CKD	1.53	0.48	10.24	1	0.001+	4.64	1.81	11.86
Loss of attachment present	Control	Ref							
	CKD	0.98	0.39	6.31	1	0.012	2.67	1.24	5.73
Fair to poor oral hygiene	Control	Ref							
	CKD	0.85	0.46	3.43	1	0.064	2.33	0.95	5.72
Moderate to severe gingival inflammation	Control	Ref							
	CKD	1.03	0.39	6.98	1	0.008	2.81	1.31	6.04

*p<0.05 statistically significant.

Among the different CKD groups, non-diabetic CKD patients who were on dialysis had more gingival inflammation (p=0.042) (Table 6).

Table 7, shows the multinomial logistic regression analysis. When compared to controls, CKD patients have more odds of having higher DMFT score, presence of gingival bleeding, periodontal pockets, loss of attachment, fair to poor oral hygiene than good oral

hygiene and moderate to severe gingival inflammation than mild gingival inflammation.

DISCUSSION

The emergence of CKD as a global public health problem is attracting increased attention worldwide as the precursor of ESRD, a severe outcome that requires dialysis or kidney transplantation.¹⁶

Because many CKD patients are not aware of the fact that they are at a higher risk of contracting oral diseases, they may not have had their dental health checked routinely. The patient's neglect of their oral health or inability to give priority to oral health would likely contribute to worse oral conditions.¹⁷

Many studies have been documented during the recent times where oral health status of kidney disease patients has been assessed. There are also studies that have compared the oral health status of kidney disease patients with healthy individuals and it is evident now that those with kidney disease have poor oral health when compared to healthy individuals. However, no study could be traced that compared oral findings between different types of CKD patients (diabetic and non-diabetic) who were undergoing dialysis and not undergoing dialysis. Therefore, this cross-sectional study was conducted to gain further insight into the oral health status in different types of CKD patients.

The study participants were in the age group of 30-70 years. In a similar study conducted by Yadav et al, the age of participants ranged between 18-70 years.¹⁸

The present study found that the mean number of decayed teeth among CKD patients were significantly lower (1.53 ± 2.15) than the controls (2.73 ± 3.21). This was in accordance to the study conducted by Tadakamadla et al and Kaushik et al, which showed that CKD patients presented significantly lower number of decayed teeth than the control group.^{11,19} But this result was contrary to the studies by Gavaldà et al and Tiwari et al where the results indicated a higher prevalence of caries among CKD patients than in controls.^{20,21} Reduced caries prevalence in CKD patients is attributed to the protective effect of metabolism of urea in saliva, which inhibits bacterial growth and neutralizes bacterial plaque acids.¹⁹

Among the CKD patients in the present study, the diabetic patients undergoing dialysis and not undergoing dialysis had higher DMFT score than the non-diabetic patients undergoing dialysis and not undergoing dialysis. This result was consistent with previous studies conducted by Asha et al and Vesterinen et al.^{4,6}

In our study, diabetic CKD patients not undergoing dialysis had a greater number of missing teeth than the other groups. Studies conducted by Naruishi et al and Chuang et al found that diabetic CKD patients on dialysis displayed a significantly higher number of missing teeth than those in the other groups. But even those studies found that diabetic CKD patients had a greater number of missing teeth than the non-diabetic CKD patients.^{22,23}

Present study revealed that patients with CKD had more periodontal pockets than the controls. Previous studies by Parkar et al and Tiwari et al also found similar results.^{24,21} This might be due the fact that the patients with CKD have neglected oral care.

Among the CKD patients, diabetic CKD patients had more periodontal pocket than non-diabetic CKD patients. This was in accordance to the results of the studies by Vesterinen et al and Swapna et al which also showed an increased periodontal pocket depth among diabetic CKD patients as compared to that of non-diabetic patients.^{6,25}

While comparing loss of attachment, the mean number of healthy sextants was significantly greater among the control group as compared to the CKD patients. Similar findings were found in studies conducted by Parkar et al and Tiwari et al.^{24,21}

The oral hygiene status revealed that CKD patients had a significantly higher OHI-S score (2.74 ± 1.16) than the controls (2.22 ± 1.29). This finding was in accordance with the study conducted by Tadakamadla et al.¹¹ It has been proposed that higher salivary urea levels in renal disease patients may be a contributing factor for heavy calculus deposition while the increased debris scores among the study group could be due to the debilitating condition of the CKD patients. Thus, the chronic nature of the disease and the debilitating general health might be a contributing factor for poor oral hygiene observed in CKD patients as they usually tend to neglect oral health because of their poor systemic health.¹⁰ Naugle et al and Parkar et al also reported that CKD patients had poor oral hygiene than the controls.^{26,24}

Our results showed that majority of the CKD patients had moderate gingival inflammation. The mean score of modified gingival index among the CKD patients was 1.69 ± 0.69 and among the controls was 1.31 ± 0.84 . Also, the mean score of modified gingival index was higher among the non-diabetic CKD patients undergoing dialysis. This finding was similar to the studies conducted by Yadav et al and Naugle et al which found that gingival inflammation was higher in patients undergoing dialysis than in controls.^{18,26} Gingival inflammation in kidney disease patients has been ascribed to poor oral hygiene and xerostomia, furthermore repeated systemic anticoagulants also increase the predisposition to gingivitis in hemodialysis patients.¹⁰

Gingival enlargement secondary to drug treatment is one of the most widely documented oral manifestations in patients with renal failure. Such enlargement can be induced by cyclosporine, which is used as immunosuppressant in transplant patients, or calcium channel blockers used in pre dialyzed and dialyzed patients for management of hypertension. The condition in turn is aggravated by the poor oral hygiene.¹⁹

The present study is not free of limitations; the study population may not represent all the chronic kidney disease patients as they were recruited from a single institution and due to the small sample size. Our study, being cross sectional in design, does not establish a cause and effect relationship. Diabetes mellitus is a risk factor for both renal and periodontal disease; therefore, further

studies are necessary to unravel the complicated relationship between these chronic diseases.

Recommendations

Comprehensive oral health care for patients with CKD is critical, as pathogenic bacteria can create a harmful environment. Good oral health mitigates the risk of infection, thereby leading to a better quality of life for the individual affected. Individuals with CKD should be placed under continuous dental observation and appropriate prevention measures to treat oral diseases should be enforced. Continuous hydration of mouth and debridement of teeth and gums are important. To reduce dry mouth, recommended use of alcohol-free mouthwashes or saliva substitute is advocated. More studies to assess the effectiveness and outcomes of implementing these initiatives are suggested.

CONCLUSION

Based on the findings of this study, it was concluded that in comparison to the controls, CKD patients had poor oral hygiene, gingival and periodontal status. In contrast, dental caries was significantly lower in CKD patients than the control group. Promoting good oral hygiene reduces the risk of oral infections. Awareness must be raised among patients undergoing dialysis, their nephrologists, and their dentists about the need for prevention of oral diseases. In addition, improving oral hygiene and performing any necessary dental treatment prior to hemodialysis or transplantation may prevent endocarditis and septicemia.

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