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Original Article

Oral health challenges in patients with chronic kidney disease: A comprehensive clinical assessment

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ABSTRACT

Loss of kidney function causes oral manifestations and multiple complications that have implications for dental treatment and patients' systemic conditions. We aimed to determine the clinical condition, epidemiological profile, and incidence of dental caries in patients with chronic kidney disease (CKD). This was an observational, cross-sectional, field study using a quantitative and epidemiological approach. The sample consisted of 45 randomly selected patients with CKD from a total of 114 patients. Data were collected through oral clinical examination, anamnesis, and medical records compiled in a clinical file specially developed for this research. Clinical evaluation was performed, including a Decayed, Missing, and Filled Teeth (DMFT) index examination. Data were analyzed using the Shapiro–Wilk test, Mann–Whitney test, and Spearman's rho coefficient. All analyses were performed using IBM SPSS Statistics software version 20.0, with a confidence interval of 95 % and significance level of 5 % ($p < 0.05$). The results indicated that CKD is more prevalent in the 5th decade of life, with a slight predilection for men. Oral cavity alterations were observed in 77.8 % of patients. The study population had a very high DMFT index, with a high number of missing teeth and a low number of decayed and filled teeth. Poor oral health in patients with CKD indicates a lack of care that supports the necessity of installing a preventive and therapeutic oral program and a regular follow-up aimed at this group of patients.

1. Introduction

The oral manifestations of chronic kidney disease (CKD) are frequent and manifest clinically. The increasing number of affected individuals and the lack of studies in this area warrant special attention in research on the oral manifestations related to CKD (Gupta et al., 2015).

Increased urea levels in the oral environment of patients with CKD can contribute to different oral alterations. These patients may present with uremic stomatitis and halitosis, alterations in salivary composition and pH, xerostomia, dysgeusias, pale oral mucosa, oral mucosa pigmentation, greater frequency of periodontal disease, dental enamel hypoplasia, osteodystrophy, amyloidosis, and ecchymosis (Anuradha et al., 2015; Gonçalves et al., 2021; Gupta et al., 2015; Marinoski et al., 2019; Rodrigues et al., 2022; Trzcionka et al., 2021).

Individuals undergoing kidney dialysis are often hospitalized for prolonged periods, affecting their quality of life (Rayner et al., 2014; Sledge et al., 2023). Dental care is uncommon among these patients, which can be explained in part by the priority dedicated to CKD treatment (Constatinides et al., 2018).

The importance of indices in research is unquestionable and becomes particularly pronounced in the context of health indices. The measurement of problems and knowledge of the situational reality of health enables the application of solutions that solve the problems detected by the indices and improve and encourage health (WHO, 2016).

This study aimed to determine the clinical conditions and epidemiological profile of patients with CKD on hemodialysis, in addition to evaluating the experience of dental caries using the DMFT index and diagnosing alterations in the oral mucosa.

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2. Material and methods

2.1. Study design

The present study consists of an observational, cross-sectional, field study, with a quantitative and epidemiological approach (Pereira et al., 2018). This study was approved by the Research Ethics Committee (protocol 2.585.926), and conducted in a hemonucleo in Paraíba, Brazil.

The sample consisted of 45 participants, based on the total number of chronic renal patients on hemodialysis treated at the reference service, with a confidence level of 95 % and an error of 10 %. The inclusion criteria were as follows: the patient had to be an adult, aged 22–80 years, of any sex, with a physical condition enabling oral examination, and had to sign a Free and Informed Consent Form, adhering to the ethical principles of the Declaration of Helsinki. Patients with a shunt in the left arm and those who were not medically stable were excluded from the study.

2.2. Clinical examination

All the participants underwent anamnesis and oral clinical examinations to collect data on their oral and general health. The data were compiled from medical records in a clinical file specifically developed for this study. The clinical evaluation for DMFT and oral mucosa was performed before hemodialysis session by a calibrated examiner.

Diabetes was observed through complementary examinations attached to the medical records according to the guidelines of the Brazilian Diabetes Society (Golbert, et al., 2021). Hypertension was evaluated using blood pressure classification according to the Brazilian hypertension guidelines (Barroso et al., 2021). Smoking and alcoholism were self-reported by the patients during anamnesis. Oral mucosal alterations were identified during clinical examination, which was accomplished according to the protocol of Santos and Motta (2022). Oral manifestations secondary to CKD and their systemic repercussions were also reported. Urea levels were observed using the serum urea level attached to the medical records. For sialometry test, the patient was instructed to expectorate into a graduated cylinder every minute for 5 min after refraining from oral hygiene, smoking, or eating for 90 min (Kubala et al., 2018). The time of nephropathy refers to the time elapsed since the first diagnosis and was verified by the description of medical records.

The experience of dental caries through the DMFT index consists of the sum of decayed, lost, and filled elements, with values ranging up to 32, based on the permanent dental elements, divided by the total number of people examined. The degree of severity is classified as: very low (0–1.1), low (1.2–2.6), moderate (2.7–4.4), high (4.5–6.5) and very high (≥6.6) (Pinto, 2000).

2.3. Statistical analysis

The data were initially analyzed using descriptive statistical analysis to characterize the sample. To verify the assumption of normality of the quantitative variables, the Shapiro–Wilk test was applied. Because this assumption was not confirmed, nonparametric statistical tests were performed. The Mann–Whitney test was performed to compare the DMFT index scores according to sex and factors including diabetes mellitus, hypertension, smoking, and alcohol consumption. Spearman's rho coefficient was used to quantify the magnitude of the correlation between the DMFT index scores and the following quantitative variables: age, time of nephropathy, sialometry, and urea (Larson and Farber, 2016). The significance level was set at 5 % ($p < 0.05$). All analyses were performed using the IBM SPSS Statistics software, version 20.0, with a confidence interval of 95 %.

3. Results

The distribution of the patients according to sex, age, duration of nephropathy, and oral manifestations is shown in Table 1.

The distribution of patients according to the DMFT index is demonstrated in Table 2.

Several associations and correlations were found between caries incidence and the other variables under investigation (Table 3). The DMFT index was significantly higher among female patients (mean = 23.77; SD = 8.16; $p = 0.007$) than among male patients (mean = 15.39; SD = 10.38), as well as among those who reported being smokers or ex-smokers (mean = 26.56; SD = 7.61; $p < 0.001$) compared to non-smokers (mean = 14.78; SD = 8.93).

On evaluating the components of the DMFT index separately, a significant positive correlation between age and the number of missing teeth (Spearman's rho = 0.812; $p < 0.001$) and a significant negative correlation between age and the number of decayed teeth (Spearman's rho = 0.465; $p = 0.001$) and filled teeth (Spearman's rho = -0.375; $p = 0.011$) were found. A significant negative correlation was found between urea levels and number of missing teeth (Spearman's rho = -0.327; $p = 0.028$).

4. Discussion

The mean age of the evaluated patients was 51.02 years with the highest concentration ranging between 41 and 60 years (49 %), indicating that CKD was more prevalent in the fifth decade of life. The sex distribution suggests that CKD has a slight male predilection, corroborating previous research (Gautam, 2014; Hecking et al., 2014; Rebolledo et al., 2012).

It was observed that 77.8 % of the participants had oral manifestations, with 14 different types of alterations detected. The most prevalent occurrence was tongue coating, which is triggered by a CKD-induced weakness, thereby diminishing the focus on oral health. The second most relevant alteration was pallor of the oral mucosa (17.8 %), a sign of anemia caused by inadequate erythropoietin production (Constantinides et al., 2018). Actinic cheilitis is one of the most common manifestations and can be explained by the high number of farmers who

Table 1
Distribution of patients with CKD according to sex, age, and oral manifestations.

Variables	n	%
Gender		
Female	22	48.9
Male	23	51.1
Age		
Mean (SD)	51.02 (14.61)	
Minimum value - maximum value	22.00–80.00	
Nephropathy time (years)		
Mean (SD)	6.54 (11.14)	
Minimum value - maximum value	0.08 – 59.00	
Oral manifestations		
Yes	35	77.8
No	10	22.2
Types of oral manifestations*		
Tongue coating	20	44.4
Mucosal pallor	8	17.8
Extra-oral amyloidosis	7	15.6
Prosthetic stomatitis	6	13.3
Actinic cheilitis	6	13.3
Reddish-orange color	6	13.3
Lymph node enlargement	4	8.9
Angular cheilitis	1	2.2
Oral petechiae	3	6.7
Morsicatio	1	2.2
Gingival hyperplasia	1	2.2
Hyperplasia in the buccal mucosa	1	2.2
Nodule in apical region	1	2.2

SD = standard deviation

Table 2
Distribution of patients according to the number of oral manifestations and components of the DMFT index.

Variables	Mean (SD)	Min – Max values
Number of oral manifestations	1.47 (1.16)	0.00–5.00
Number of decayed teeth	1.84 (2.62)	0.00–9.00
Number of missing teeth	16.49 (12.00)	0.00–32.00
Number of teeth filled	1.22 (2.80)	0.00–15.00
DMFT index	19.49 (10.18)	1.00–32.00

SD: standard deviation; Min: minimum; Max: maximum.

Table 3
Analysis of association/correlation between dental caries experience, sociodemographic characteristics, diabetes, hypertension, smoking, alcohol consumption, duration of nephropathy, sialometry, and serum urea level.

Variables		Decayed teeth	Missing teeth	Filled teeth	DMFT
		M (SD)	*M* (SD)	*M* (SD)	*M* (SD)
Gender	Female	1.23 (2.39)	20.95 (11.14)	1.73 (3.74)	23.77 (8.16)
	Male	2.43 (2.74)	12.22 (11.42)	0.74 (1.36)	15.39 (10.38)
	p-value[(a)]	0.062	**0.017***	0.588	**0.007***
Diabetes	Yes	1.79 (2.36)	20.79 (11.00)	0.57 (1.16)	23.14 (9.05)
	No	1.87 (2.77)	14.55 (12.09)	1.52 (3.26)	17.84 (10.36)
	p-value[(a)]	0.883	0.110	0.306	0.107
Hypertension	Yes	2.45 (2.91)	14.35 (11.73)	0.68 (1.33)	17.48 (9.99)
	No	0.50 (0.94)	21.21 (11.62)	2.43 (4.50)	23.93 (9.46)
	p-value[(a)]	**0.034***	0.061	0.121	0.052
Drink or have drank alcohol	Yes	2.83 (3.19)	17.83 (12.24)	0.50 (1.22)	21.17 (9.47)
	No	1.69 (2.54)	16.28 (12.11)	1.33 (2.97)	19.23 (10.37)
	p-value[(a)]	0.284	0.649	0.414	0.710
Smoker or ex-smoker	Yes	1.44 (2.50)	24.72 (9.78)	0.39 (0.92)	26.56 (7.61)
	No	2.11 (2.71)	11.00 (10.15)	1.78 (3.46)	14.78 (8.93)
	p-value[(a)]	0,226	< **0.001***	0.058	**<0.001***
Age	Spearman's rho coefficient	−0,465	0.812	−0.375	0.757
	p-value[(b)]	**0.001***	< **0.001***	**0.011***	< **0.001***
Nephropathy time (years)	Spearman's rho coefficient	−0.140	−0.019	0.067	−0.015
	p-value[(b)]	0.359	0.901	0.660	0.921
Sialometry (mL/min)	Spearman's rho coefficient	−0.259	0.084	0.103	0.019
	p-value[(b)]	0.086	0.583	0.500	0.903
Urea (mg/dL)	Spearman's rho coefficient	0.227	−0.327	0.153	−0.289
	p-value[(b)]	0.134	**0.028***	0.315	0.054

M: mean; SD: standard deviation; ex-smoker: person who no longer smokes.

reported not using solar protection. Patients undergoing hemodialysis have a lower deposition of nitrogenous waste in the blood (Vadakedath and Kandi, 2017). Therefore, uremic stomatitis is a probable manifestation that was not observed in this study, demonstrating treatment efficacy (Alshammari and Issrani, 2022).

Regarding the average DMFT index, the studied population presented a very high DMFT index (Pinto, 2000), corroborating previous research (Camacho-Alonso et al., 2018). Recent findings have shown a relatively higher average for missing teeth and a low average for decayed and filled teeth. Despite advances in renal treatment, dentistry continues to lag behind in addressing the needs of this population (Costantinides et al., 2018). Given that dentists are not commonly included in multidisciplinary teams in Brazilian hospitals, it is critical to evaluate access to oral health services in patients with CKD. This suggests the need for an oral preventive and therapeutic program aimed at this group of patients, as well as regular follow-up to educate them on the importance of oral health owing to their systemic condition (Miranda et al., 2015).

A significant positive correlation was found between the number of missing teeth and age, which can be attributed to the natural process of tooth loss and the absence of specific programs targeting this population. (Sethi et al., 2022).

No statistically significant correlations were found between DMFT and sialometry or the duration of nephropathy, corroborating the results of a previous study (Alshammari and Issrani, 2022).

Hypertension and number of decayed teeth were significantly and positively correlated. Reduced salivary flow is a side effect of antihypertensive medications (Sethi et al., 2022). The quantity and quality of salivary changes have been widely correlated with an increased incidence of caries (Menezes et al., 2019).

There was a significant negative correlation between urea and missing teeth. Research is needed to better understand this correlation, a limitation of this study. Serum urea levels observed were consistently elevated, confirming that patients undergoing dialysis have serum urea levels up to five times higher than the general population. (Menezes et al., 2019). High levels of salivary urea are correlated with a low prevalence of caries. The longer the duration of renal failure, the greater the impact on the occurrence of caries. (Menezes et al., 2019).

Previous study suggests that tooth loss can be explained by the high prevalence of periodontitis (Serni et al., 2023). However, not knowing when individuals lost their dental elements is a limitation of the study, which may have occurred prior to the onset of nephropathy. Therefore, oral hygiene practices, frequency of visits to the dentist, and previous dental history are factors that can exclude kidney disease as a factor in the deterioration of oral health.

Although nephrologists are aware of periodontal disease and its implications for disease progression, only a minority include dental treatment information in their anamneses. (Mana et al., 2013). These patients do not prioritize dental hygiene, and the majority are unable to work, resulting in limited financial resources and substantial difficulty in accessing public or private dental treatment owing to prolonged hospitalization for hemodialysis, which contributes to the onset of periodontal disease.

Although no significant correlation was found between DMFT and diabetes, studies have shown significant differences in DMFT rates between patients with (17.75) and without diabetes (7.14) (Swapna et al., 2017). Furthermore, no significant correlation was found between alcoholism and DMFT scores, although studies have found significantly different rates between alcoholics (14.9) and non-alcoholics (7.9) (Manicone et al., 2017). In contrast to previous studies, smokers had significantly higher DMFT values with a significant difference (Manicone et al., 2017).

5. Conclusion

This study highlights the need for special attention to patients with CKD, as many oral complications can arise from CKD itself or associated comorbidities. Furthermore, poor oral health in patients with CKD demonstrates a lack of care, indicating the need for a preventive and therapeutic oral program and regular follow-up aimed at this group of patients.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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