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Original Article

End Stage Renal Disease and Its Effects on Periodontal Health, Salivary pH, and Flow Rate

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ABSTRACT

End-stage renal disease (ESRD) is the final stage of chronic kidney disease and is associated with several systemic complications that may affect oral health. Additionally, renal impairment can alter salivary pH and reduce salivary flow rate, which may further influence oral and periodontal conditions. **Objectives:** To evaluate the periodontal status (using plaque index and gingival index), salivary pH, and salivary flow rate in patients with end-stage renal disease (ESRD) in comparison to systemically healthy controls. **Methods:** A cross-sectional group comparative study with a total of 100 participants, 50 diseased ESRD patients, and 50 systemically healthy controls. were assessed. The oral health status was assessed using the Gingival Index and the Plaque Index. Unstimulated saliva was measured using the Spitting Method. The pH of the saliva was assessed by pH Indicator Strips. **Results:** Participants were 60% males and 40 % females. 63% participants brushed daily, and only 28% brushed twice. The brushing time reported by 51% participants was 1-2 minutes. 51% reported never visiting the dentist. Significant positive association was found between ESRD and systemically healthy controls in change of salivary pH ($p=0.004$), PI status ($p=0.010$), and salivary flow rate ($p<0.001$). However, gingival status showed no association with ESRD ($p=0.066$). **Conclusions:** Patients with end-stage renal disease (ESRD) demonstrated poorer periodontal status and altered salivary pH and flow rate compared to systemically healthy controls.

INTRODUCTION

Chronic kidney disease (CKD) is characterized by gradual deterioration in renal function that occurs progressively over the course of several years. Clinically, it is classified as either renal impairment or a glomerular filtration rate that persistently appears below the normal value for a duration of three months or longer (i.e., 60 ml/min/1.73 m2), irrespective of the underlying cause [1]. In the modern world, chronic kidney disease (CKD) is seen as a substantial and critical public healthcare dilemma [2]. The global prevalence of CKD is estimated at 13.4% (with a range of 11.7% to 15.1%). The incidence of chronic kidney disease (CKD) has been seen comparatively much higher in females when compared to the male population with prevalence data from international studies showing higher rates in females [3, 4]. However, these estimates are from UK and US populations and may not be generalizable to Pakistan [3, 4]. The prevalence of CKD varies, and in Pakistan, the overall prevalence was reported to be 12.5% (with a range of

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11.4% to 13.8%) [5]. The global prevalence of CKD was determined to be 13.4% when considering stages 1-5, and 10.6% when specifically focusing on stages 3-5 [6]. These stages are categorized according to the National Kidney Foundation in the manner outlined [7]. Due to advancements in clinical management leading to longer survival times for kidney failure patients, it is anticipated that the multitude of oral manifestations appeared to be linked to oral hygiene practices, dietary and environmental influences, as well as the disease itself and its treatment, may manifest in individuals with ESRD [8].The benefits of employing the oral cavity as a diagnostic tool lie in its easy accessibility, comfort, and capacity to facilitate non-invasive tests [9]. A comprehensive assortment of oral manifestations has been intricately documented and observed in the care recipients of End-Stage Renal Disease (ESRD) patients [10]. These oral manifestations can be attributed to an array of variable factors, including the medications used in their treatment, which include Alpha-Adrenergic Blockers, Antihypertensives, and Benzodiazepines. Hypo-salivation also lays the groundwork for such ailing individuals to various oral health concerns such as dental carious lesions, periodontitis, and candida infestation, atrophy of the salivary glands, and restrictions on fluid intake, multi-systematic and salivary-related changes resulting from prolonged renal impairment, poly-drug therapy, bouts of nausea, and lessened self-directed oral care [11]. Moreover, several observational and cohort studies have demonstrated that periodontal disease severity tends to worsen as kidney function declines, suggesting a progressive relationship between CKD stage and oral health deterioration [12].

Furthermore, there is limited local data, especially from developing countries like Pakistan, assessing the combined effects of ESRD on periodontal health and salivary characteristics. This study provides region-specific evidence that can help clinicians better understand the oral manifestations of ESRD within the local population. The findings may support the integration of dental care into routine medical management for ESRD patients, promote interdisciplinary collaboration, and contribute to the development of preventive strategies and clinical guidelines tailored to this high-risk group. By evaluating these oral parameters, this study aimed to highlight the need for early identification and management of periodontal disease and salivary dysfunction in ESRD patients, which may ultimately improve their overall health outcomes and quality of life.

METHODS

A cross-sectional comparative study was conducted with the approval of the Bahria University of Health Sciences, Karachi, Institutional Review Board, BUHSC-IRB #040/24, on 3 Jan 2024, in a time frame of six months (From 4 January 2024 to 4 July 2024). The study group comprised 100 patients with end-stage renal disease (ESRD) having been diagnosed in about half (50 participants) of the given individuals. This sample size was calculated using mean differences of Plaque Index means and SD of the ESRD group (2.2 ± 0.6) and the control group (comparison group) (1.9 ± 0.6), and keeping CI 95% and Power 80%, the calculated sample size was 100, i.e., 50 per group [13]. Individuals were selected using non-random purposive sampling, due to the need for specifically identified ESRD patients from nephrology departments, as random sampling was not feasible in this hospital-based setting. Patients with ESRD being managed by the Nephrology department of SWAAB Kidney Care and Dialysis Centre and Jinnah Postgraduate Medical Centre (JPMC). Participants aged 30 years and above who provided informed consent were included in the study. Patients with ESRD on dialysis were included irrespective of associated comorbidities such as hypertension and diabetes, as these conditions commonly coexist with renal disease. Information regarding smoking status and recent antibiotic use was recorded but not used as exclusion criteria. However, due to the small sample size, these variables were not adequately controlled for in the analysis. The healthy group consisted of 50 clinically healthy subjects. If they had a normal estimated glomerular filtration rate (GFR) value of higher than 90 ml/min per 1.73 m2 of body surface area, they were recruited as healthy group subjects. The GFR was assessed using the Cockcroft and Gault equation. However, body weight and serum creatinine measurement were not standardized, which may affect GFR estimation accuracy. Unstimulated salivary flow rate was measured (ml/min). Based on standard criteria, hyposalivation was defined as <0.1 ml/min, normal salivation as 0.1–0.5 ml/min, and hypersalivation as >0.5 ml/min. The Gingival Index by Loe and Silness in 1963 was used to assess the gingival status of the present individuals. Subsequently, the results were compared with those of the healthy group, and the data were analyzed. Saliva collection was performed at a standardized time (morning) to minimize diurnal variation. However, hydration status was not controlled or recorded. No adjustment for comorbidities was performed due to the lack of multivariate analysis.

The results were presented as mean SD. SPSS version 23.0 was used for the statistical analyses. The difference in saliva flow rates, pH, GI, and PI between healthy and ESRD-affected individuals was analyzed using the Chi-square test. Continuous variables (salivary flow rate and pH) were categorized for analysis, which reduces statistical power and information.

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RESULTS

The study summarizes the demographic and clinical characteristics of the study participants. The sample showed a slightly higher proportion of males (60%) compared to females (40%). Half of the participants were ESRD patients on dialysis, while the remaining half were healthy controls. Most participants were government or private employees, and the majority reported no recent antibiotic use (76%). Among medical conditions, hypertension was the most common comorbidity (28%), while other conditions, such as diabetes, hepatitis, and bleeding disorders, were less frequently observed (Table 1).

Table 1: Demographic, Medical, and Antibiotic Use Characteristics of Study Participants (n=100)

Variables	n (%)
Gender	
Male	60 (60%)
Female	40 (40%)
Profession	
Housewife	33 (33%)
Armed Forces personnel	12 (12%)
Private employees	23 (23%)
Unemployed	7 (7%)
Government Employees	25 (25%)
Presence of Systemic Disease	
ESRD on Dialysis	50 (50%)
Systemically Healthy Controls. (No Systemic Disease)	50 (50%)
Medical History	
Hypertension Only	28 (28%)
Diabetes Only	3 (3%)
Hepatitis	3 (3%)
Bleeding Disorder	2 (2%)
Diabetes and Hypertension	14 (14%)
No Systemic Disease	50 (50%)
Antibiotic Use	
No Antibiotic Use in Past 6 Months	76 (76%)
Used Antibiotics Within Past 3 Months	10 (10%)
Used Antibiotics Between 3-6 Months	6 (6%)
Used Antibiotics More Than 6 Months Ago	8 (8%)

The present study compares oral hygiene practices and habits between ESRD patients and systemically healthy controls using the Chi-square test. The results showed no statistically significant differences between the two groups in brushing frequency (χ^2, p=0.185), dental visit patterns (p=0.230), brushing duration (p=0.389), or oral habits (p=0.737). Key findings indicated that a higher proportion of ESRD patients reported once-daily brushing (72% vs 56%) and irregular dental visits (58% vs 44%) compared to systemically healthy controls. While brushing duration of more than one minute was slightly higher among systemically healthy controls (58% vs 44%). Overall, all comparisons remained statistically non-significant (p>0.005) (Table 2).

Table 2: Association Test for Categorical Variables for Dental History

Variables	ESRD, n (%)	Systemically Healthy Controls, n (%)	p-value
Brushing Frequency			
Never	2 (4%)	2 (4%)	0.185
Once Daily	36 (72%)	28 (56%)	
Twice Daily	11 (22%)	17 (34%)	
Three Times A Day	2 (4%)	3 (6%)	
Dental Visits			
Never	29 (58%)	22 (44%)	0.230
More than 6 months	10 (20%)	17 (34%)	
Less than 6 months	9 (18%)	11 (22%)	
Duration of Brushing			
Less Than One Minute	19 (38%)	14 (28%)	0.389
More Than One Minute	22 (44%)	29 (58%)	
More Than Two Minutes	5 (10%)	7 (14%)	
Habits			
Pan	5 (10%)	6 (12%)	0.737
Chalia	4 (8%)	8 (16%)	
Niswar	4 (8%)	3 (6%)	
Tobacco	5 (10%)	3 (6%)	
None	29 (58%)	30 (60%)	

The results compare oral and salivary health parameters between ESRD patients and healthy controls using the chi-square test. Key findings showed significantly higher basic pH in ESRD patients and greater plaque accumulation compared to controls (p=0.004 and p=0.010, respectively). Salivary dysfunction was more prominent in the ESRD group, with significantly reduced salivation rate and flow rate (p<0.001). Gingival index showed no statistically significant difference between groups (p=0.066) For gingival index, the p-value was 0.066, and effect sizes or confidence intervals were not calculated (Table 3).

Table 3: Association Test for Change in Oral Health Status in ESRD Patients

Variables	ESRD (n=50), n (%)	Systemically Healthy Controls (n=50), n (%)	p-value
pH Status			
Normal	9 (18%)	22 (44%)	0.004
Acidic	16 (32%)	23 (46%)	
Basic	25 (50%)	5 (10%)	
Plaque Index (PI) Status			
No plaque	8 (16%)	20 (40%)	0.010
Plaque on 1/3	16 (32%)	11 (22%)	
Moderate Plaque on 2/3	24 (48%)	13 (26%)	
Abundant Plaque >2/3	2 (4%)	6 (12%)	
Gingival Index (GI) Status			
Normal	11 (22%)	20 (40%)	0.066
Mild	14 (28%)	16 (32%)	
Moderate	23 (46%)	11 (22%)	

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Severe	2 (4%)	3 (6%)	
Rate of Salivation			
Normal	2 (4%)	27 (54%)	0.001
Hyposalivation	30 (60%)	18 (36%)	
Hypersalivation	18 (36%)	5 (10%)	
Salivary Flow Rate (ml/min)			
Normal 0.3–0.4	0 (0%)	28 (56%)	0.001
Hypersalivation >0.4	21 (42%)	8 (16%)	
Hyposalivation <0.3	29 (58%)	14 (28%)	

Rate of Salivation' and 'Salivary Flow Rate' are similar parameters measured differently, potentially causing redundancy in presentation

DISCUSSION

The study population in the present research comprised 60% males and 40% females, showing a male predominance in ESRD patients. This finding is consistent with recent evidence reported by Kovesdy *et al.* who demonstrated that although CKD prevalence is slightly higher in females, disease progression and adverse outcomes are more pronounced in males [14]. Similarly, a recent analysis by the Australian Institute of Health and Welfare reported that the burden of CKD was approximately 1.3 times higher in males compared to females [15]. In comparison, a more recent observational study (2017–2023) reported by Minutolo *et al.* found 59% males and 41% females among advanced CKD patients starting nephrology care, which closely aligns with the present study findings [16]. Likewise, a meta-analysis by Hill *et al.* showed that males constituted around 62% of participants in CKD and dialysis-related cohorts [17]. Therefore, the male predominance observed in this study (60%) is consistent with recent international data, supporting the trend of higher progression to ESRD among males. A recent cross-sectional study by Basha *et al.* evaluated periodontal and salivary alterations in patients undergoing hemodialysis and reported significantly higher plaque accumulation, increased periodontal parameters, and altered salivary biomarkers compared to healthy controls [18]. Similarly, a study Bayraktar *et al.* (2007),. confirmed that CKD patients commonly exhibit hyposalivation, increased calculus formation, and elevated salivary pH, along with greater periodontal destruction [13]. The review emphasized that these changes become more pronounced with disease progression and dialysis duration. This strongly supports the current study findings, where ESRD patients showed significantly higher basic salivary pH, reduced salivary flow rate, and increased prevalence of hyposalivation compared to controls. Furthermore, a scoping review by Kaymaz *et al.* reported that ESRD patients consistently demonstrate reduced salivary flow rate, increased gingival inflammation, and higher plaque scores than systemically healthy controls. across multiple observational studies [19]. The authors also noted that altered salivary composition and reduced buffering capacity contribute to periodontal deterioration. Additionally, a considerable proportion of the patients had never visited a dentist. Although the study did not demonstrate a statistically significant association between dental hygiene practices and ESRD, the clinical findings indicate that dental care utilization and oral hygiene practices were generally poor among ESRD patients. This trend may be attributed to prioritization of systemic disease management over oral health care, limited awareness, and barriers to accessing dental services [20]. Systematic reviews examining patients undergoing peritoneal dialysis or hemodialysis have also emphasized the clinical significance of periodontal disease in CKD patients. These studies recommend incorporating periodontal evaluation and treatment into the comprehensive management plan for individuals with chronic kidney disease [21]. Hemodialysis appears to help maintain salivary pH within normal limits despite metabolic disturbances associated with renal disease. For example, an Indian study reported mean salivary pH values of 6.49 ± 1.1 before hemodialysis and 6.65 ± 0.60 after dialysis, with no statistically significant difference between the two measurements[22].

Several limitations exist. The relatively small sample size and single-center design may limit generalizability, with purposive sampling further introducing selection bias. Patients were recruited from a specific hospital setting, which may not fully represent the diversity of ESRD patients in the community. The cross-sectional nature restricts the ability to establish causality between ESRD and oral health changes. Salivary parameters can be affected by hydration status and time of collection, which were not fully standardized. Smoking and antibiotic use were recorded but not controlled for, and comorbidities such as hypertension and diabetes were not adjusted for. GFR estimation in healthy controls lacked standardization for body weight and serum creatinine. Continuous variables were categorized, losing statistical power, and no multivariate analysis was performed to adjust for confounders. Effect sizes and confidence intervals were not reported for the non-significant gingival index finding (p=0.066). The absence of longitudinal follow-up limits assessment of disease progression over time. Despite these limitations, this study provides valuable preliminary data on oral health parameters in Pakistani ESRD patients. Future studies with larger, multicenter samples, multivariate analysis, and longitudinal designs are recommended to validate and expand upon these findings.

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CONCLUSIONS

ESRD is associated with altered salivary pH (p=0.004), reduced flow rate (p<0.001), and increased plaque (p=0.010). However, gingival index showed no significant difference (p=0.066), suggesting periodontal inflammation may not be uniformly affected. ESRD is associated with xerostomia, but causality cannot be established. Clinicians should consider routine oral health assessment for ESRD patients. Future studies with multivariate analysis and longitudinal designs are needed.

Authors' Contribution

Conceptualization: MMH
Methodology: MMH, LK, MM
Formal analysis: MMH
Writing and Drafting: BK, NFN, MM, MA, KFR
Review and Editing: MMH, LK, BK, NFN, MM, MA, KFR, RK

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflict of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Gharavi AG and Landry DW. Approach to the Patient with Renal Disease. Goldman-Cecil Medicine. 2024.

[2] Lv JC and Zhang LX. Prevalence and Disease Burden of Chronic Kidney Disease. In Renal Fibrosis: Mechanisms and Therapies. Singapore: Springer Singapore. 2019 Aug: 3-15. doi: 10.1007/978-981-13-8871-2_1.

[3] Hirst JA, Hill N, O'Callaghan CA, Lasserson D, McManus RJ, Ogburn E *et al.* Prevalence of Chronic Kidney Disease in the Community Using Data from Oxren: A UK Population-Based Cohort Study. British Journal of General Practice. 2020 Feb. doi: 10.3399/bjgp20X708245.

[4] Velan E and Sheller B. Oral Health in Children with Chronic Kidney Disease. Pediatric Nephrology. 2021 Oct; 36(10): 3067-75. doi: 10.1007/s00467-020-04913-9.

[5] Imtiaz S, Alam A. Epidemiology and Demography of Chronic Kidney Disease in Pakistan: A Review of Pakistani Literature. Pakistan Journal of Kidney Diseases. 2023 Mar; 7(1): 2-7. doi: 10.53778/pjkd71209.

[6] Nylund KM, Meurman JH, Heikkinen AM, Furuholm JO, Ortiz F, Ruokonen HM. Oral Health in Patients with Renal Disease: A Longitudinal Study from Predialysis to Kidney Transplantation. Clinical Oral Investigations. 2018 Jan; 22(1): 339-47. doi: 10.1007/s00784-017-2118-y.

[7] Kesmez Ö, Frøjk MJ, Eidemak I, Jensen SB, Kragelund C. Oral Symptoms and Pathologies in Danish Patients with Chronic Kidney Disease-A Pilot Study. Acta Pathologica, Microbiologica, et Immunologica Scandinavica. 2020 May; 128(5): 401-5. doi: 10.1111/apm.13042.

[8] Andaloro C, Sessa C, Bua N, Mantia IL. Chronic Kidney Disease in Children: Assessment of Oral Health Status. Dental and Medical Problems. 2018; 55(1): 23-8. doi: 10.17219/dmp/81747.

[9] Rodrigues RP, Vidigal MT, Vieira WA, Nascimento GG, Sabino-Silva R, Blumenberg C *et al.* Salivary Changes in Chronic Kidney Disease and in Patients Undergoing Hemodialysis: A Systematic Review and Meta-Analysis. Journal of Nephrology. 2022 Jun; 35(5): 1339-67. doi: 10.1007/s40620-022-01274-4.

[10] Kamath G and Devananda D. Prevalence of Xerostomia in Patients on Hemodialysis: A Systematic Review and Meta-Analysis. Gerodontology. 2021; 38(03): 235-41. doi: 10.1111/ger.12526.

[11] Marakoglu I, Gursoy UK, Demirer S, Sezer H. Periodontal Status of Chronic Renal Failure Patients Receiving Hemodialysis. Yonsei Medical Journal. 2003 Aug; 44(4): 648-52. doi: 10.3349/ymj.2003.44.4.648.

[12] Nascimento MA, Soares MS, Küstner EC, Dutra DM, Cavalcanti RL. Oral Symptoms and Oral Health in Patients with Chronic Kidney Disease. RGO-Revista Gaúcha de Odontologia. 2018 Jun; 66(02): 160-5. doi: 10.1590/1981-86372018000200093436.

[13] Bayraktar GÖ, Kurtulus I, Duraduryan A, Cintan S, Kazancioglu RÜ, Yildiz A, Bural C *et al.* Dental and Periodontal Findings in Hemodialysis Patients. Oral Diseases. 2007 Jul; 13(4): 393-7.

[14] Kovesdy CP. Epidemiology of Chronic Kidney Disease: An Update 2022. Kidney International Supplements. 2022 Apr; 12(1): 7-11. doi: 10.1016/j.kisu.2021.11.003.

[15] Australian Institute of Health and Welfare. Chronic Kidney Disease. 2024.

[16] Minutolo R, Gabbai FB, Chiodini P, Provenzano M, Borrelli S, Garofalo C *et al.* Sex Differences in the Progression of CKD Among Older Patients: Pooled Analysis of 4 Cohort Studies. American Journal of Kidney Diseases. 2020 Jan; 75(1): 30-8. doi: 10.1053/j.ajkd.2019.05.019.

[17] Hill NR, Fatoba ST, Oke JL, Hirst JA, O'Callaghan CA, Lasserson DS *et al.* Global Prevalence of Chronic

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DOI: https://doi.org/10.54393/pjhs.v7i10.4127

Kidney Disease–A Systematic Review and Meta-Analysis. Plos One. 2016 Jul; 11(7): e0158765. doi: 10.1371/journal.pone.0158765.

[18] Basha MM, Al-Kadasi BA, Al-Hajri M, Al-Sharani HM, Elayah SA. Exploring the Correlation Between Periodontal Disease and Serum Biomarkers in Hemodialysis Patients. BioMed Central Oral Health. 2024 Sep; 24(1): 1066. doi: 10.1186/s12903-024-04826-1.

[19] Kaymaz K, Brunet-Llobet L, Rocha-Eiroa MD, Ramirez-Ramiz A, Mahmoud MA, Mashala EI *et al.* Patient-Related Factors That Link Chronic Kidney Disease and Periodontitis: A Scoping Review. Odontology. 2025 Jul; 113(3): 865-77. doi: 10.1007/s10266-024-01031-y.

[20] Sabharwal A, Stellrecht E, Scannapieco FA. Associations Between Dental Caries and Systemic Diseases: A Scoping Review. BioMed Central Oral Health. 2021 Sep; 21(1): 472. doi: 10.1186/s12903-021-01803-w.

[21] Cardoso EM, Reis C, Manzanares-Céspedes MC. Chronic Periodontitis, Inflammatory Cytokines, and Interrelationship with Other Chronic Diseases. Postgraduate Medicine. 2018 Jan; 130(1): 98-104. doi: 10.1080/00325481.2018.1396876.

[22] Parsegian K, Randall D, Curtis M, Ioannidou E. Association Between Periodontitis and Chronic Kidney Disease. Periodontology 2000. 2022 Jun; 89(1): 114-24. doi: 10.1111/prd.12431.

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