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Oral Health in Chronic Hemodialysis: Changes in Periodontal, Mucosal and Temporomandibular Findings between 2022 and 2024

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Abstract

Background: *Patients receiving maintenance hemodialysis frequently present oral alterations involving periodontal tissues, oral mucosa, teeth, and the temporomandibular joint. However, repeated assessments of oral health within the same dialysis service are uncommon, particularly in Latin America.*

Objective: *To compare the frequency and pattern of selected oral manifestations among patients receiving chronic hemodialysis at a regional referral hospital in Paraguay in 2022 and 2024.*

Materials and Methods: *A comparative repeated cross-sectional study was conducted using two clinical surveys performed among patients receiving maintenance hemodialysis at the Hospital Regional de Concepción, Paraguay. The 2022 survey included 39 patients and the 2024 survey included 30 patients. Comparable periodontal, dental, mucosal, and temporomandibular findings were identified in both datasets. Prevalence differences were calculated in percentage points, and categorical comparisons were explored using Fisher's exact test. Because some periodontal definitions differed between surveys, comparisons involving attachment loss and periodontitis were interpreted descriptively.*

Results: *Gingivitis increased from 41.0% (16/39) in 2022 to 80.0% (24/30) in 2024 (p=0.001), while dental erosion increased from 12.8% (5/39) to 43.3% (13/30) (p=0.006). Temporomandibular dysfunction increased from 5.1% (2/39) to 30.0% (9/30) (p=0.007). In contrast, oral mucosal pallor decreased from 71.8% (28/39) to 40.0% (12/30) (p=0.013). Dental caries remained frequent, increasing from 64.1% to 73.3%, although the difference was not statistically significant (p=0.447). Candidiasis increased from 2.6% to 13.3% (p=0.159). Periodontal tissue involvement remained frequent in both surveys.*

Conclusion: *Patients receiving chronic hemodialysis showed a persistently high burden of oral disease, with marked differences between 2022 and 2024 in gingival inflammation, dental erosion, mucosal pallor, and temporomandibular dysfunction. These findings support incorporating periodic oral assessment into multidisciplinary hemodialysis care and justify prospective studies using standardized dental and periodontal criteria.*

Keywords: *Renal Insufficiency, Chronic; Renal Dialysis; Oral Health; Periodontal Diseases; Mouth Mucosa; Temporomandibular Joint Disorders.*

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I. INTRODUCTION

Chronic kidney disease (CKD) is a systemic disorder characterized by progressive loss of kidney function and a broad spectrum of metabolic, inflammatory, hematological, immune, and mineral-bone abnormalities. These systemic disturbances may also affect the oral environment. Patients with advanced CKD, particularly those receiving maintenance hemodialysis, may experience periodontal inflammation, dental caries, calculus accumulation, xerostomia, altered taste, oral mucosal abnormalities, gingival enlargement, candidiasis, dental erosion, and temporomandibular disorders [1–3].

The relationship between CKD and periodontal disease has attracted increasing attention because both conditions share inflammatory pathways and major comorbidities. Systematic reviews and meta-analyses have

consistently demonstrated a higher prevalence and severity of periodontal disease among individuals with CKD, although substantial heterogeneity exists in periodontal definitions, kidney disease stages, and clinical populations [4–6]. Oral mucosal abnormalities and opportunistic infections have also been reported in hemodialysis populations [7,8], while temporomandibular disorders represent another potentially overlooked component of the oral disease burden [9]. These findings have practical relevance because patients with kidney disease may require specific dental management, especially when kidney transplantation is being considered [10].

More recent evidence reinforces the concept that oral abnormalities may emerge throughout the spectrum of CKD rather than being confined to kidney failure. A 2026 systematic review and meta-analysis examining stages 1–4 CKD demonstrated alterations in several oral-health parameters and emphasized the importance of recognizing oral deterioration before kidney failure develops [12]. In patients with more advanced CKD, oral infections, including periodontal and apical disease, are frequent and may vary according to treatment stage [13]. In the multinational ORAL-D cohort, patients treated with hemodialysis exhibited a substantial burden of dental, periodontal, mucosal, and salivary abnormalities, highlighting the global dimension of oral disease in this population [14].

Periodontal involvement appears particularly relevant in dialysis populations. Earlier clinical investigations demonstrated unfavorable periodontal conditions among both predialysis and maintenance dialysis patients [23,35]. The association is unlikely to be explained by a single pathway. CKD and periodontal disease share risk factors including advanced age, diabetes mellitus, smoking, socioeconomic disadvantage, and chronic inflammatory activation [19,28,34]. Furthermore, structural equation modelling has suggested an interrelationship between periodontal inflammation and kidney function involving systemic oxidative stress, although observational data cannot establish directionality or causality [30].

The clinical relevance of oral disease in kidney failure may extend beyond local discomfort or tooth loss. Cohort studies have reported associations between periodontal disease and mortality among patients receiving hemodialysis [16,33], and periodontal disease has also been associated with pneumonia-related mortality in this population [15]. Among adults with stages 3–5 CKD, periodontitis has similarly been associated with increased mortality [18]. Conversely, not all studies have demonstrated an independent mortality association after adjustment for potential confounders [27], indicating that the prognostic significance of periodontal disease remains complex.

Other dimensions of oral health also appear clinically important. In a three-year cohort of patients receiving hemodialysis, poor oral hygiene and dental caries predicted higher mortality [22]. The multinational ORAL-D study similarly found associations between measures of dental health and mortality [25], while oral mucosal lesions were associated with subsequent all-cause and cardiovascular mortality [26]. Periodontitis has also been associated with impaired oral health-related quality of life among individuals with end-stage kidney disease [29]. These observations do not establish causation but suggest that oral health may function as a marker of broader clinical vulnerability.

Salivary dysfunction constitutes another plausible contributor to the oral phenotype of patients undergoing hemodialysis. Reduced salivary flow and xerostomia may influence oral discomfort, caries risk, mucosal integrity, and susceptibility to infection. Interventional research demonstrating that salivary flow can be modified in hemodialysis patients provides further evidence that salivary impairment is clinically relevant rather than merely an incidental finding [24]. Biochemical abnormalities associated with kidney failure may also correlate with oral-health parameters [11].

Importantly, periodontal disease represents a potentially modifiable condition. Non-surgical periodontal treatment has been evaluated in patients with kidney disease. A randomized clinical trial in patients with end-stage renal disease demonstrated systemic effects following periodontal therapy [17]. Systematic reviews have subsequently evaluated whether periodontal treatment could influence systemic inflammation and renal outcomes, with encouraging but still inconclusive findings [20,21,32]. More recently, a 2026 randomized controlled trial reported improvements in inflammatory markers and renal-function-related outcomes following non-surgical periodontal therapy among patients with CKD [31]. These findings strengthen the rationale for closer collaboration between nephrology and dentistry while underscoring the need for larger trials before periodontal treatment can be considered a kidney-directed intervention.

The oral-health profile of patients receiving hemodialysis remains comparatively understudied in Latin America. In 2022, a clinical examination of 39 patients undergoing chronic hemodialysis at the Hospital Regional de Concepción in northern Paraguay identified a high frequency of dental calculus, mucosal pallor, dental caries, periodontal attachment loss, gingivitis, dental mobility, and other oral abnormalities [1]. The availability of a second assessment performed within the same dialysis service in 2024 created an opportunity to examine whether the distribution of clinically relevant oral manifestations remained similar or differed over time.

Repeated cross-sectional assessments cannot demonstrate individual disease progression, but they may provide a practical form of clinical surveillance in chronic dialysis populations. Changes in the prevalence of periodontal, mucosal, dental, or temporomandibular findings can identify emerging healthcare needs and help guide integrated preventive strategies.

Therefore, the objective of this study was to compare selected periodontal, dental, mucosal, and temporomandibular findings among patients receiving chronic hemodialysis at the Hospital Regional de Concepción, Paraguay, in 2022 and 2024.

II. MATERIALS AND METHODS

Study design and setting

A comparative repeated cross-sectional study was conducted using data from two clinical oral-health assessments performed in patients receiving maintenance hemodialysis at the Hospital Regional de Concepción, Concepción, Paraguay.

The first assessment was conducted in 2022 and included 39 patients receiving chronic hemodialysis. Findings from this cohort were previously reported as a descriptive cross-sectional study [1]. The second assessment was performed in 2024 and included 30 patients from the same hemodialysis service.

The present study represents a new comparative analysis of oral-health findings recorded during these two periods rather than longitudinal follow-up of individual patients.

Study population

The 2022 cohort consisted of 39 patients aged 20–80 years with CKD undergoing maintenance hemodialysis at the Hospital Regional de Concepción. Twenty-six participants (66.7%) were male and 13 (33.3%) were female.

The 2024 survey comprised 30 patients receiving chronic hemodialysis at the same institution.

Because individual-level linkage between the two surveys was not available for the present analysis, the samples were considered independent cross-sectional populations.

Oral assessment

During the 2022 study, participants underwent a structured clinical examination conducted by previously calibrated faculty members and students. Assessment included palpation of the temporomandibular joint, extraoral examination, and systematic intraoral inspection involving the buccal mucosa, oral mucosa, hard palate, tongue, teeth, and supporting periodontal tissues [1].

The principal findings recorded included dental calculus, mucosal pallor, dental caries, attachment loss, gingivitis, dental mobility, gingival enlargement, fissured tongue, halitosis, xerostomia, gingival bleeding, dental erosion, coated tongue, temporomandibular dysfunction, candidiasis, and other oral manifestations.

For the comparative analysis, findings with corresponding information available in both surveys were selected. These included gingivitis, dental caries, periodontal involvement, dental erosion, mucosal pallor, temporomandibular dysfunction, and candidiasis.

The periodontal variables require particular caution. The 2022 assessment reported loss of periodontal attachment, whereas the 2024 assessment recorded periodontitis. Because these are related but not identical diagnostic constructs, they were considered indicators of periodontal tissue involvement but were not treated as strictly equivalent outcomes for inferential interpretation.

Statistical analysis

Categorical variables were summarized as absolute frequencies and percentages.

For findings measured comparably in both surveys, absolute prevalence changes were expressed in percentage points. Fisher's exact test was used for exploratory comparisons because of the relatively small sample sizes and the presence of cells with low expected frequencies.

A two-sided p-value <0.05 was considered statistically significant. Given the exploratory nature of the comparison and limited sample size, p-values were interpreted together with the magnitude and clinical direction of observed differences rather than as definitive evidence of temporal causality.

Ethical considerations

The study used clinical information collected without identifying individual patients. The corresponding institutional ethical approval and authorization information for the 2024 assessment should be reported in the final submitted version:

Ethics approval:

III. RESULTS

A total of 39 patients were evaluated in the 2022 survey and 30 in the 2024 survey.

In 2022, all participants presented at least one oral manifestation. The most frequent findings were dental calculus (76.9%), mucosal pallor (71.8%), dental caries (64.1%), periodontal attachment loss (48.7%), gingivitis (41.0%), dental mobility (38.5%), and gingival enlargement (35.9%). Other findings included fissured tongue (23.1%), halitosis (20.5%), xerostomia (17.9%), gingival bleeding (17.9%), dental erosion (12.8%), coated tongue (7.7%), temporomandibular dysfunction (5.1%), and candidiasis (2.6%).

The oral-health profile observed in 2024 differed in several clinically relevant domains. Gingivitis was identified in 80.0% (24/30), dental caries in 73.3% (22/30), periodontitis in 56.7% (17/30), dental erosion in 43.3% (13/30), mucosal pallor in 40.0% (12/30), temporomandibular dysfunction in 30.0% (9/30), and candidiasis in 13.3% (4/30).

Table 1. Comparison of selected oral findings among patients receiving chronic hemodialysis, 2022 and 2024

Oral finding	2022 n=39	2024 n=30	Absolute change	Fisher's exact p
Gingivitis	16 (41.0%)	24 (80.0%)	+39.0 pp	0.001
Dental caries	25 (64.1%)	22 (73.3%)	+9.2 pp	0.447
Dental erosion	5 (12.8%)	13 (43.3%)	+30.5 pp	0.006
Mucosal pallor	28 (71.8%)	12 (40.0%)	−31.8 pp	0.013
Temporomandibular dysfunction	2 (5.1%)	9 (30.0%)	+24.9 pp	0.007
Candidiasis	1 (2.6%)	4 (13.3%)	+10.7 pp	0.159
Periodontal involvement*	19 (48.7%)	17 (56.7%)	+8.0 pp	—

Oral finding	2022 n=39	2024 n=30	Absolute change	Fisher's exact p
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Dental caries	25 (64.1%)	22 (73.3%)	+9.2 pp	0.447
Dental erosion	5 (12.8%)	13 (43.3%)	+30.5 pp	0.006
Mucosal pallor	28 (71.8%)	12 (40.0%)	−31.8 pp	0.013
Temporomandibular dysfunction	2 (5.1%)	9 (30.0%)	+24.9 pp	0.007
Candidiasis	1 (2.6%)	4 (13.3%)	+10.7 pp	0.159
Periodontal involvement*	19 (48.7%)	17 (56.7%)	+8.0 pp	—

*2022: periodontal attachment loss; 2024: periodontitis. Because the operational definitions differed, statistical comparison was not considered appropriate.

pp: percentage points.

The comparative distribution of the selected oral manifestations is shown in Figure 1. The graphical representation highlights the substantial increases in gingivitis, dental erosion, and temporomandibular dysfunction in the 2024 assessment, as well as the reduction in mucosal pallor. Dental caries and periodontal involvement remained frequent in both assessment periods.

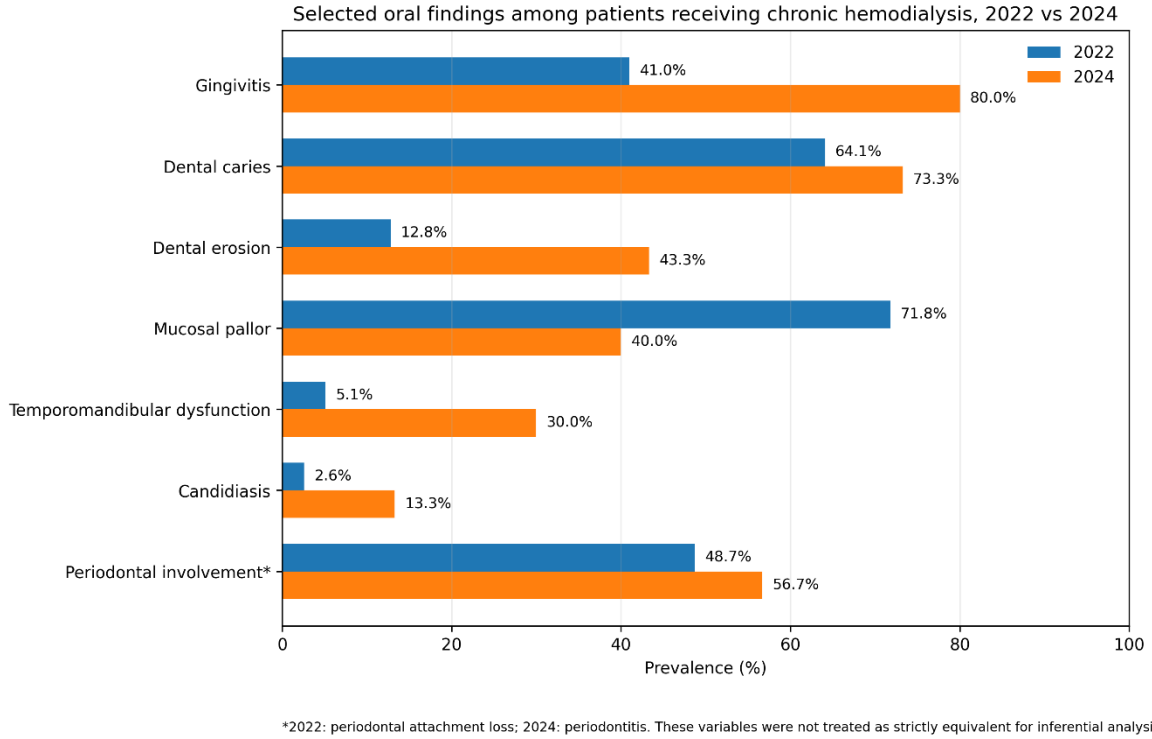

Figure 1. Comparison of selected oral findings among patients receiving chronic hemodialysis in 2022 and 2024. Values are expressed as percentages. The largest absolute increases were observed for gingivitis (+39.0 percentage points), dental erosion (+30.5 percentage points), and temporomandibular dysfunction (+24.9 percentage points), whereas mucosal pallor decreased by 31.8 percentage points. *Periodontal involvement corresponds to periodontal attachment loss in 2022 and periodontitis in 2024; because these definitions are not strictly equivalent, this comparison is presented descriptively.*

Gingivitis showed the largest increase between assessment periods, rising from 41.0% (16/39) in 2022 to 80.0% (24/30) in 2024, corresponding to an absolute difference of 39.0 percentage points (p=0.001).

Dental erosion also increased markedly, from 12.8% (5/39) in 2022 to 43.3% (13/30) in 2024, an absolute increase of 30.5 percentage points (p=0.006).

Temporomandibular dysfunction increased from 5.1% (2/39) to 30.0% (9/30), representing an absolute difference of 24.9 percentage points (p=0.007).
Conversely, mucosal pallor decreased from 71.8% (28/39) in 2022 to 40.0% (12/30) in 2024, corresponding to an absolute reduction of 31.8 percentage points (p=0.013).
Dental caries remained highly prevalent in both assessment periods, increasing from 64.1% to 73.3%; however, this difference was not statistically significant (p=0.447).
Candidiasis was numerically more frequent in 2024, increasing from 2.6% (1/39) to 13.3% (4/30), although the difference did not reach statistical significance (p=0.159).
Periodontal tissue involvement remained frequent in both surveys. However, because the 2022 assessment documented periodontal attachment loss whereas the 2024 assessment recorded periodontitis, the observed difference was interpreted descriptively and no inferential statistical comparison was performed.

IV. DISCUSSION

This repeated cross-sectional study identified a substantial oral-disease burden among patients receiving maintenance hemodialysis at a regional referral hospital in northern Paraguay. Beyond the high prevalence of oral abnormalities in both assessment periods, the principal finding was a marked difference in the distribution of specific manifestations between 2022 and 2024. Gingivitis, dental erosion, and temporomandibular dysfunction were substantially more frequent in the 2024 sample, whereas mucosal pallor was less frequent. Dental caries and periodontal tissue involvement remained common in both periods.

These findings are consistent with an expanding body of evidence demonstrating that CKD is accompanied by substantial oral-health impairment. Recent systematic evidence indicates that oral alterations can be detected even before kidney failure and tend to become more prominent as renal disease advances [12]. Studies specifically involving dialysis populations have reported high levels of periodontal disease, dental pathology, mucosal abnormalities, oral-hygiene deficiencies, and salivary dysfunction [13,14,23,35]. Therefore, the high burden observed in our population is unlikely to be unique to the Hospital Regional de Concepción; rather, it appears to form part of a broader oral phenotype associated with advanced CKD and maintenance dialysis.

The increase in gingivitis from 41.0% in 2022 to 80.0% in 2024 was the largest absolute change observed in this study. Periodontal inflammation has repeatedly been associated with CKD. Several systematic reviews and meta-analyses support a greater prevalence or severity of periodontitis among patients with kidney disease [4–6,20,21,28]. Clinical studies involving dialysis populations have similarly described unfavorable periodontal conditions [23,35].

Multiple pathways may contribute to this association. Patients with advanced CKD have a high prevalence of diabetes, cardiovascular disease, chronic inflammation, oxidative stress, malnutrition, altered immune function, and socioeconomic barriers to preventive healthcare. Several of these factors are also established determinants of periodontal disease. Epidemiological studies have highlighted the importance of shared vulnerability and confounding factors when interpreting the association between kidney and periodontal disease [19,34]. Furthermore, mechanistic clinical research has identified systemic oxidative stress as a potential link between periodontal inflammation and renal function [30].

However, the increase in gingivitis in the present study should not be interpreted as evidence that individual patients experienced periodontal deterioration between 2022 and 2024. The surveys involved independent cross-sectional samples and did not include individual-level longitudinal linkage. Changes in age distribution, diabetes prevalence, dialysis vintage, oral-hygiene behavior, smoking, medication exposure, access to dental care, or examiner-related factors could have contributed to the difference.

An additional methodological consideration is the definition of periodontal disease. The 2022 assessment documented periodontal attachment loss, whereas the 2024 survey recorded periodontitis. Contemporary periodontal research emphasizes the importance of standardized case definitions [4,5,20,21,28]. Attachment loss is an important component of periodontal assessment but is not equivalent by itself to a complete periodontitis diagnosis. Consequently, we deliberately avoided performing an inferential statistical comparison between these two variables. Future assessments should use a standardized periodontal protocol incorporating probing depth, clinical attachment level, bleeding on probing, tooth loss attributable to periodontitis, and contemporary staging and grading criteria.

Dental caries was highly prevalent in both periods, affecting 64.1% of patients in 2022 and 73.3% in 2024. Although this difference was not statistically significant, the persistence of a high caries burden is clinically important. Studies of patients receiving hemodialysis have similarly demonstrated considerable dental treatment needs [2,3,14,22,25].

The clinical importance of dental disease in this population may extend beyond tooth preservation. Mizutani et al. reported an association between poor oral hygiene, dental caries, and mortality in a three-year hemodialysis cohort [22], while the multinational ORAL-D study demonstrated associations between dental-health indicators and subsequent mortality [25]. These observational associations should not be interpreted as proof that

dental disease directly causes mortality; oral deterioration may also act as a marker of frailty, socioeconomic disadvantage, comorbidity burden, nutritional problems, or reduced access to healthcare.

The increase in dental erosion from 12.8% to 43.3% represents another important finding. Potential mechanisms in kidney failure include changes in salivary quantity and composition, gastrointestinal symptoms, dietary exposures, medication use, and modifications in oral pH. Salivary dysfunction has been documented in dialysis populations, and the demonstration that salivary flow can be modified experimentally in patients receiving hemodialysis supports its clinical relevance [24]. Nevertheless, the present dataset did not include salivary flow, oral pH, dietary acidity, gastroesophageal reflux, vomiting, medication exposure, or biochemical parameters specifically linked to erosion. Accordingly, the observed increase should be considered an epidemiological signal rather than evidence of a renal-specific causal mechanism.

Oral mucosal pallor decreased substantially, from 71.8% in 2022 to 40.0% in 2024. Mucosal abnormalities are well documented in advanced CKD and hemodialysis [7,14,26]. Pallor may reflect anemia, although clinical inspection of mucosal color is not sufficiently specific to establish hematological status.

The decrease observed in 2024 could theoretically be related to differences in hemoglobin concentrations, anemia management, iron status, erythropoiesis-stimulating agent use, nutritional status, or patient composition. However, these variables were not available for the present comparative analysis. It would therefore be inappropriate to attribute the lower prevalence of pallor to improved anemia control without supporting biochemical data. Future studies should specifically correlate oral mucosal findings with hemoglobin, ferritin, transferrin saturation, nutritional indices, and dialysis-related variables.

The numerical increase in candidiasis, from 2.6% to 13.3%, did not reach statistical significance. Patients undergoing hemodialysis may be susceptible to oral Candida colonization or infection because of diabetes, immune dysfunction, xerostomia, antibiotic exposure, prosthetic appliances, and other clinical factors [8]. Multinational data have also demonstrated the clinical relevance of oral mucosal lesions in dialysis populations [26]. Nevertheless, only five candidiasis cases were recorded across both assessments, producing substantial statistical uncertainty around the observed difference.

Temporomandibular dysfunction increased from 5.1% in 2022 to 30.0% in 2024. Temporomandibular disorders have previously been described among patients receiving chronic hemodialysis [9], although this aspect of oral health remains much less extensively investigated than periodontal disease or xerostomia.

Possible contributing factors include chronic pain, sleep disturbances, psychosocial stress, parafunctional activity, muscular dysfunction, and abnormalities of mineral and bone metabolism. None of these factors was measured in the current study, and variations in clinical examination techniques could also influence detection. The magnitude of the observed difference nevertheless suggests that temporomandibular assessment may merit inclusion in future standardized oral-health protocols for dialysis populations.

An important development in the kidney–oral health literature is the transition from simple prevalence studies toward evaluation of clinically meaningful outcomes. Several cohort studies have examined whether periodontal or dental disease identifies patients at increased systemic risk.

Chen et al. reported a relationship between periodontal disease and mortality among patients receiving maintenance hemodialysis [16]. Kshirsagar et al. similarly observed poorer survival among patients with end-stage kidney disease and periodontal disease [33], while Iwasaki et al. demonstrated an association between periodontal disease and pneumonia mortality [15]. In patients with stages 3–5 CKD, periodontitis has also been associated with increased mortality [18].

However, the evidence is not entirely consistent. A multinational propensity-matched analysis from the ORAL-D cohort did not demonstrate a clear independent association between periodontitis and early mortality after adjustment [27]. This discrepancy is important because it argues against interpreting periodontal disease as a direct causal determinant of death on the basis of observational evidence alone.

A more appropriate interpretation may be that poor oral health identifies a subgroup with accumulated biological and social vulnerability. Shared risk factors—including diabetes, smoking, aging, inflammation, socioeconomic disadvantage, reduced healthcare access, and multimorbidity—may partly explain these relationships [28,34]. Oral disease could therefore represent both a clinically relevant condition requiring treatment and a potential marker of broader health inequalities.

The possibility that periodontal treatment may influence systemic inflammation or kidney-related outcomes provides additional biological plausibility to the nephrology–dentistry interface. Fang et al. demonstrated systemic changes following non-surgical periodontal therapy in a randomized controlled trial involving patients with end-stage renal disease [17]. Earlier systematic evidence suggested that periodontal treatment may reduce systemic inflammatory markers, although effects on kidney function remained uncertain [20].

A subsequent systematic review evaluating periodontal treatment in CKD similarly concluded that potential improvements in inflammatory and renal parameters were promising but that available evidence was heterogeneous and limited by small studies [32]. Most recently, Kouris et al. reported in a randomized controlled

trial that non-surgical periodontal therapy was accompanied by reductions in high-sensitivity C-reactive protein and favorable changes in renal-function-related outcomes over six months [31].

These findings are clinically interesting but should not be extrapolated to the present study, which did not evaluate periodontal treatment. They do, however, reinforce the rationale for integrating periodontal assessment and treatment into comprehensive CKD care and for conducting adequately powered trials with standardized renal and periodontal endpoints.

Oral health also affects dimensions of health that may not be captured through mortality or laboratory outcomes. Periodontitis has been associated with poorer oral health-related quality of life among individuals with end-stage renal disease [29]. Pain, tooth loss, mastication difficulties, xerostomia, altered taste, mucosal discomfort, and aesthetic consequences may compound the already considerable symptom burden associated with maintenance hemodialysis.

This patient-centered perspective is particularly relevant because individuals receiving dialysis devote substantial time to renal replacement therapy and frequently prioritize immediate medical problems over preventive dental care. Periodic oral evaluation incorporated into dialysis programs may reduce the need for patients to independently navigate another fragmented healthcare pathway.

The findings support a model in which oral health is considered part of comprehensive hemodialysis care rather than an unrelated dental issue. Basic standardized screening could identify gingival inflammation, dental caries, mucosal abnormalities, oral infection, xerostomia, and temporomandibular symptoms and establish criteria for referral to dental services.

Interdisciplinary collaboration may be especially important in patients being evaluated for kidney transplantation, where identification and management of potential oral infectious foci have particular clinical relevance [10]. The broader literature also suggests that periodontal treatment may have systemic inflammatory benefits, although current evidence does not justify treating periodontal therapy as a substitute for established nephrological treatment [17,31,32].

For regional hospitals serving geographically dispersed populations, periodic dental assessment within the dialysis unit could also improve access by bringing preventive services closer to patients who already face a substantial treatment burden.

Strengths and limitations

This study has several strengths. It provides evidence from an underrepresented population in northern Paraguay, combines nephrological and dental perspectives, and compares oral-health findings obtained within the same hemodialysis service at two different time points. The study also moves beyond a single descriptive prevalence estimate by exploring whether the oral-health profile of the dialysis population changed over time.

Several limitations must be acknowledged. First, both samples were small and derived from a single center. Second, the design was repeated cross-sectional rather than longitudinal, and patients could not be individually linked between assessment periods. Third, information on several potential confounders—including age distribution in 2024, diabetes, smoking, dialysis vintage, oral-hygiene practices, socioeconomic status, medication exposure, salivary flow, biochemical variables, anemia treatment, and previous dental care—was unavailable for adjusted analyses.

Fourth, diagnostic criteria were not completely standardized between surveys, particularly for periodontal disease. Fifth, examiner- or protocol-related differences could have influenced detection frequencies. Sixth, multiple exploratory comparisons were performed in relatively small samples, and the reported p-values should consequently be interpreted together with effect magnitude and clinical plausibility rather than as definitive evidence of temporal change.

Finally, the present study cannot determine whether the differences observed between 2022 and 2024 resulted from biological changes, differences in population composition, changes in access to dental care, or measurement-related factors.

Despite these limitations, the magnitude of the observed differences in gingivitis, dental erosion, mucosal pallor, and temporomandibular dysfunction indicates that the oral-health profile of a dialysis population should not be assumed to remain static. Repeated standardized assessments could provide a feasible surveillance strategy to identify evolving oral-health needs.

V. CONCLUSION

Patients receiving chronic hemodialysis at the Hospital Regional de Concepción showed a substantial burden of oral disease in both 2022 and 2024, but the distribution of individual manifestations differed between the two assessment periods.

The 2024 survey showed substantially higher frequencies of gingivitis, dental erosion, and temporomandibular dysfunction, whereas mucosal pallor was less frequent. Dental caries and periodontal involvement remained common in both periods.

Because the study compares independent cross-sectional samples, these findings should not be interpreted as evidence of individual disease progression or causal temporal trends. Instead, they demonstrate differences in the oral-health profile of a chronic dialysis population over time.

Periodic standardized oral assessment, closer collaboration between nephrology and dentistry, and prospective studies using consistent periodontal and dental diagnostic criteria are warranted. Future research should additionally incorporate dialysis vintage, diabetes, anemia parameters, mineral-bone markers, salivary function, medications, oral-hygiene practices, socioeconomic variables, and patient-reported oral-health outcomes.

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability

The datasets contain clinical information from patients receiving hemodialysis and are therefore not publicly available. Anonymized data may be made available by the corresponding author upon reasonable request and subject to institutional and ethical requirements.

Author Contributions

Raúl Desvars: Conceptualization, methodology, formal analysis, interpretation of results, supervision, visualization, writing—original draft, and writing—review and editing.

Adriana Fabiola Galeano Cabral: Methodology, oral clinical assessment, data collection, interpretation of results, and writing—review and editing.

Alberto Moisés Vera León: Data collection, oral clinical assessment.

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Laura María Cabrera Talavera: Data collection, oral clinical assessment.

Elena Schupp: Clinical interpretation, nephrological assessment, validation, and writing—review and editing.

Jorge Rojas: Clinical interpretation, validation, and writing—review and editing.

Gabriela Fernandez: Clinical interpretation, validation.

All authors reviewed and approved the final version of the manuscript and agreed to be accountable for the work.

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