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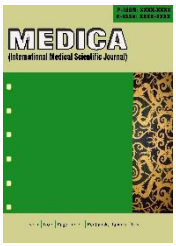

The Periodontal Tissue Health Status of Patients with Chronic Kidney Disease

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Abstract

Chronic Kidney Disease (CKD) is a significant global health issue, affecting approximately 700 million people worldwide. This study investigates the periodontal health of CKD patients in Banyumanik District, Semarang, Central Java, Indonesia, where the prevalence of CKD is notably high. A cross-sectional analysis involving 44 CKD patients from three community health centers was conducted. Data were collected through medical records and periodontal examinations using the Community Periodontal Index of Treatment Needs (CPITN) and the Gingival Index (GI). Results indicated that 70% of participants exhibited moderate to severe gingival inflammation, with an average GI score of 1.75. The majority required phase I periodontal treatment, including scaling and root planning. Significant correlations were found between gingival inflammation and factors such as hemodialysis history and the duration of CKD. Patients undergoing hemodialysis showed higher levels of gingival inflammation compared to those who were not. The findings highlight the critical need for regular periodontal assessments and interventions in CKD patients to mitigate oral health complications and improve overall quality of life. This study underscores the importance of integrating oral health management into the care of CKD patients, particularly in regions with high prevalence rates.

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1. INTRODUCTION

Chronic kidney disease (CKD) is a kidney disease caused by progressive kidney damage. CKD is currently a trending issue due to significant global health problems, and its prevalence has increased significantly in almost all countries. Approximately 700 million people worldwide, or more than 10% of the global population, suffer from CKD. Based on the Global Burden of Disease (GBD), the prevalence of CKD increased by 33% from 1990 to 2017 and is expected to continue to increase (Francis et al., 2024). Based on the 2018 Indonesian Basic Health Research, the prevalence of CKD was 6.7% (of the population examined), with a 95% confidence interval between 6.4% and 7.1%. Central Java is one of the provinces in Indonesia with the third highest CKD rate, where the prevalence of CKD in 2018 was 8.7%, or higher than the prevalence of CKD in Indonesia (Kementerian Kesehatan Republik Indonesia, 2018). Based on the Indonesian Health Survey, approximately 88 thousand people of the Central Javanese population have been diagnosed with CKD (Kementerian Kesehatan Republik Indonesia, 2023).

CKD requires special attention because it has a significant health burden for the country. In addition, it triggers serious complications, which may reduce the quality of life. CKD causes a high mortality rate, with an estimated 5 million deaths per year out of the 11 million deaths caused by all kidney diseases. CKD is also a significant risk factor for cardiovascular disease, which accounts for many kidney-related deaths. In addition, CKD contributes to significant disability and reduced quality of life. Patients with CKD often experience severe symptoms, such as fatigue, itching, and pain, which can interfere with their daily activities (Kementerian Kesehatan Republik Indonesia, 2018).

Banyumanik is one of the sub-districts in Semarang Regency, Central Java, Indonesia. So far, there has been no research conducted related to periodontal health in CKD patients in that area. Based on a survey, it was found that the number of CKD patients in this sub-district is relatively high and increases every year (Dinas Kesehatan Kota Semarang, 2021). The selection of Banyumanik District in Semarang as the location of the study was based on preliminary survey data of local public health which showed a significant trend of increasing CKD sufferers but was not accompanied by adequate awareness of dental health. Most patients in this region report subjective complaints in the oral cavity, but objective data regarding the severity of their gum inflammation have not been well documented.

CKD patients often show poor periodontal health and quality of life related to oral health. Several studies have shown that CKD has a significant impact on periodontal health. Patients with CKD often show more severe periodontal disease compared to healthy individuals. CKD not only causes severe uremic conditions in patients, but also triggers systemic inflammation, immune system disorders, and poor oral hygiene (Krishnan et al., 2023; Parsegian et al., 2022; Tawfig et al., 2016). CKD patients tend to have higher levels of inflammatory markers and more severe periodontitis compared to non-CKD individuals (Chaudhry et al., 2022).

CKD patients often neglect periodontal health management. Studies revealed that CKD patients, especially those undergoing hemodialysis, are at higher risk for periodontal problems (Garneata et al., 2015). Non-surgical periodontal therapy can significantly improve periodontal parameters and reduce inflammatory markers in CKD patients. CKD patients tend to have worse gingival index and Community Periodontal Index of Treatment Needs (CPITN) than the general population (Chaudhry et al., 2022).

Although the link between kidney disease and periodontal health has been widely discussed in the international literature, most studies have focused on patients who have already undergone hemodialysis in large hospitals. The research gap in this study lies in

the lack of data that integrates the specific oral hygiene behavior of suburban communities in Banyumanik with the clinical profile of CKD sufferers. Most previous studies have focused on central hospital populations in large cities, so generalizing these results to local populations with different health access can lead to clinical management bias.

CIPTN and GI are functional parameters for assessing periodontal health in CKD patients. This tool helps identify the severity of periodontal disease and the necessary treatment interventions. Given the high prevalence of periodontal problems in CKD patients, routine periodontal assessment using CIPTN might aid early detection and management, thereby improving overall health outcomes (Krishnan et al., 2023; Tawfig et al., 2016).

Therefore, this study aims to analyze in depth the health status of periodontal tissue in CKD patients in Banyumanik District using the parameters of Gingival Index (GI) and Community Periodontal Index of Treatment Needs (CPITN). Through the identification of the severity and need for treatment, it is hoped that the results of this research can be the basis for health policy makers at Puskesmas to integrate periodontal examinations into routine management protocols for chronic kidney disease patients to prevent further deterioration in quality of life.

2. METHOD

This study employed an analytical cross-sectional design to examine the periodontal health status of patients with Chronic Kidney Disease (CKD). The cross-sectional approach enabled the simultaneous assessment of kidney disease characteristics and periodontal health conditions to identify potential associations between these variables. The study was conducted at three community health centers (Puskesmas) in Banyumanik District, Semarang, Central Java, Indonesia, namely Padangsari Health Center, Ngesrep Health Center, and Srondol Health Center. These facilities were selected because they provide primary healthcare services for a representative population of CKD patients.

The target population consisted of all patients diagnosed with CKD within the working areas of the selected health centers, totaling 50 individuals. The minimum sample size was calculated using the Isaac and Michael formula with a 5% margin of error, resulting in a required sample of 44 participants. A consecutive sampling technique was applied, whereby all eligible patients attending the health centers during the study period were recruited until the required sample size was achieved. Participants were included if they had a confirmed medical diagnosis of CKD, possessed at least one natural tooth, and provided written informed consent. Patients who declined participation, were edentulous, were pregnant, were heavy smokers, or were in a critical or medically unstable condition that prevented oral examination were excluded from the study.

Data collection involved both primary and secondary data sources. Primary data were obtained through direct clinical oral examinations performed by a calibrated dentist. Prior to examination, participants were instructed to rinse their mouths to ensure optimal assessment conditions. Periodontal health status was assessed using the Community Periodontal Index of Treatment Needs (CPITN) and the Gingival Index (GI). Clinical examinations were conducted using a WHO periodontal probe and mouth mirror under adequate lighting conditions to minimize measurement bias.

The CPITN assessment was used to evaluate periodontal treatment needs based on the presence of bleeding on probing, calculus, and periodontal pocket depth. All teeth were examined at six sites, including mesiobuccal, midbuccal, distobuccal, mesiolingual or mesiopalatal, midlingual or midpalatal, and distolingual or distopalatal surfaces. The highest score observed within each sextant was recorded as the representative CPITN score.

Scores ranged from healthy periodontal conditions to the presence of deep periodontal pockets requiring complex periodontal treatment.

Gingival health was evaluated using the Gingival Index developed by Löe and Silness (Tawfig et al., 2016). The assessment considered gingival color, contour, bleeding tendency, and the extent of inflammation on four tooth surfaces: facial, mesial, distal, and lingual or palatal. Gingival inflammation was categorized as healthy, mild, moderate, or severe based on the mean GI score. The final GI score for each participant was calculated by summing the scores from all examined surfaces and dividing by the total number of indexed tooth surfaces examined.

Secondary data were obtained from patients' medical records and included information regarding CKD duration, history of hemodialysis treatment, and the presence of comorbid conditions. These variables were collected to support the analysis of factors potentially associated with periodontal health status among CKD patients.

Data were analyzed using statistical software. Descriptive statistics were used to summarize participants' demographic and clinical characteristics. Prior to inferential analysis, data normality was assessed using the Shapiro–Wilk test. Because periodontal clinical data were not normally distributed, the relationships between CKD-related variables, including disease duration and hemodialysis status, and periodontal health indicators were analyzed using Spearman's rank correlation test. Correlation coefficients were interpreted to determine the strength and direction of associations, with statistical significance established at $p < 0.05$.

This study received ethical approval from the Health Research Ethics Committee of the Poltekkes Kemenkes Semarang (No. 1129/EA/F.XXIII.38/2024) before data collection commenced. All participants were informed about the objectives, procedures, benefits, and potential risks of the study. Written informed consent was obtained from all participants, and confidentiality and anonymity were maintained throughout the research process. Participants were also informed of their right to withdraw from the study at any time without any consequences.

3. RESULTS AND DISCUSSION

This study involved a total of 44 respondents who were patients of Chronic Kidney Disease (CKD) in the Banyumanik District area, Semarang.

Table 1. Respondent Descriptive Analysis (n= 44).

Variable	N	Percentage (%)
Age		
< 30 years	4	9.1
31-40 years	6	13.6
41-50 years	7	15.9
51-60 years	11	25.0
> 60 years	16	36.4
Gender		
Male	29	65.9
Female	15	34.1
Congenital abnormalities		
No	42	95.5
Yes	2	4.5
Family History		
Cardiovascular disease	2	4.5

Diabetes mellitus	5	11.4
Hypertension	10	22.7
Others	7	15.9
Absence	20	45.5
Gingival index a*	1.75 (0.5-3.0)	

**a: Mean (minimum-maximum value)*
N: Total respondents

Based on Table 1, the majority of respondents in this study were in the age group of late adults and the elderly, with the highest percentage in the age category over 50 years old at 61.4% (27 respondents). Judging from the gender aspect, male respondents dominated the study population with a total of 29 people (65.9%) compared to women as many as 15 people (34.1%). Most respondents (95.5%) stated that they did not have a congenital kidney disorder. However, there are significant findings on the family history of systemic diseases, where Hypertension is the most reported comorbid disease (22.7%), followed by Diabetes Mellitus (6.8%). These demographic characteristics and health history give an idea that the population of CKD patients in Banyumanik District is dominated by the elderly group with fairly high metabolic risk factors.

The dominance of the age group over 50 years in this study is in line with the nature of the progressivity of Chronic Kidney Disease (CKD). As we age, there is a physiological decline in glomerular filtration function, which is often exacerbated by other degenerative diseases. The higher prevalence of men is also consistent with global epidemiological data showing that men have a greater risk of exposure to inflammatory factors for kidney damage, such as lifestyle and smoking habits, although disease progression can vary between genders (Adibelli & Duran, 2021; Lim & Lee, 2022; Vladu et al., 2019).

The findings regarding the high history of hypertension (22.7%) in respondent families are a crucial point. Hypertension is not only a leading cause of vascular damage to the kidneys, but it also has direct implications for periodontal health. Uncontrolled hypertension can trigger microcirculation disorders, including in the gum tissue. In addition, the use of certain anti-hypertensive medications (such as *calcium channel blockers*) is often associated with side effects such as *gingival enlargement*, which can worsen the *Gingival Index score* and complicate plaque control in patients (Nitta et al., 2014; Wirnsberger, 2018).

Therefore, the profile of respondents who are dominated by the elderly with hypertension comorbidities explains why all subjects in this study experienced inflammation of periodontal tissue. Age factors and systemic diseases collectively degrade the regenerative ability of periodontal tissue and exacerbate the inflammatory response to the accumulation of bacterial plaques in the oral cavity.

Table 2. CKD Status (n= 44).

Variable	**N**	**Percentage (%)**
Duration of CKD		
1-2 years	23	52.3
3-4 years	8	18.2
5-6 years	6	13.6
> 6 years	7	15.9
Hemodialysis History		
No	16	36.4
Yes	28	63.6
Complication		

Variable	N	Percentage (%)
Cardiovascular disease	2	4.5
Diabetes mellitus	3	6.8
Hypertension	9	20.5
Others	15	34.1
Absence	15	34.1

Table 2 shows that most of the respondents have suffered from CKD for a long period of time, with the majority being in the range of 1 to 2 years duration. Regarding kidney replacement therapy procedures, more than half of the respondents (52.3%) were patients who routinely underwent hemodialysis, while the remaining 47.7% were in the predialysis stage or undergoing other conservative management.

The findings that 52.3% of respondents underwent hemodialysis had significant clinical implications for the condition of their periodontal tissue. Patients undergoing long-term hemodialysis often experience complex systemic changes (Burnier & Damianaki, 2023). Based on the literature, the hemodialysis process is related to the condition of persistent uremia that can cause platelet dysfunction and suppression of the immune system. This explains why in clinical examinations, respondents in this group tended to show higher Gingival Index *scores and* bleeding on probing gums (Carrero et al., 2017).

In addition, the predominantly duration of the disease ranges from 1–5 years to allow enough time for systemic risk factors to manifest in the oral cavity. The accumulation of metabolic residues that are not fully filtered by the kidneys can trigger *low-grade systemic inflammation* (Kaupke et al., 1996). This inflammation accelerates the breakdown of collagen fibers in the periodontal ligaments and the resorption of alveolar bones (Parsegian et al., 2022).

Table 3. Periodontal Tissue Health Status (n= 44).

Variable	N	Percentage (%)
Gingival index		
Mild	16	36.4
Moderate	15	34.1
Severe	13	29.5
CPITN		
No treatment required	0	
Oral hygiene instruction (OHI)	12	27.3
OHI, scaling and polishing	22	50
OHI, deep scaling, and root planning	8	18.2
Scaling, root planning, and surgical intervention	2	4.5

Periodontal tissue health status refers to the health condition of the tissues surrounding and supporting the teeth. All respondents experienced gingival inflammation, exceptionally mild gingival inflammation (36.4%), and above 60% experienced progressive gingival inflammation. However, 70% of respondents needed phase I treatment, namely scaling and root planning, and to improve habits to maintain dental and oral health. Treatments needed were presented in Table 3.

Gingival inflammation in CKD patients undergoing hemodialysis is also significantly higher than in those without hemodialysis. The hemodialysis process may affect the vulnerability of CKD patients. During hemodialysis, drugs that trigger bleeding are often used, such as anticoagulants (Königsbrügge et al., 2021). The hemodialysis process may also change the profile of immune cells (leukocytes), thus affecting their activity. Several studies have shown that the number of monocytes increases in CKD patients undergoing

hemodialysis. However, their function could be more optimal due to the contact of leukocytes with the dialyzer membrane, which can activate the complement system, which causes damage to immune cells (Kaupke et al., 1996; Liakopoulos et al., 2018; Nathalya Dwi et al., 2020).

In addition, gingival inflammation in respondents undergoing hemodialysis can be due to uremia. Uremic levels in CKD patients are likely to be still relatively high even though patients have undergone hemodialysis, thus triggering gingival inflammation (Palmeira et al., 2024). Chronic and severe uremic conditions will complicate the clearance process by hemodialysis treatment. Uremia causes platelet dysfunction and decreased erythropoietic acid, so bleeding will quickly occur during the probing (Hamza et al., 2020; Laky et al., 2020).

Most of the respondents in this study experienced progressive gingival inflammation based on the gingival index and required phase 1 treatment, namely DHE, scaling and root planning. Respondents likely need phase 1 treatment as an effort to control plaque, considering that CKD patients tend to have poor oral health and a high risk of periodontal disease. Plaque control is an effort to maintain dental health and oral cavity tissue, thereby preventing gingival inflammation and the progression of gingivitis to periodontitis. This plaque control can be done mechanically and chemically, and other oral hygiene measures, including the frequency of brushing teeth and professional tartar cleaning. Especially for CKD patients, plaque control is essential because CKD patients tend to experience inflammation and damage to periodontal tissue due to uremia, nutritional deficiencies and xerostomia (Menezes et al., 2019; Owlia et al., 2000; Ruokonen et al., 2019).

Table 4. Gingival inflammation of respondents.

Variable	Gingival index		Periodontal treatment needs	
	SD	p-value	SD	p-value
History of hemodialysis				
No	0.70 ± 0.54	0.001a	18.06	0.054a
Yes	1.81 ± 0.98		1.81 ± 0.98	
Duration of CKD				
1-2 years	1.05 ± 0.76d	0.022b	17.41d	0.001b
3-4 years	1.19 ± 0.91d		21.38d	
5-6 years	1.60 ± 1.25		25.67d	
> 6 years	2.29 ± 1.06a,b		37.79 a,b,c	
Complication				
Cardiovascular disease	2.45 ± 0.78d	0.001b	38.50 c,d	0.006b
Diabetes mellitus	2.60 ± 0.61c,d		33.50c	
Hypertension	1.28 ± 1.06b		14.06e	
Others	0.67 ± 0.45a,b,e		18.83a	
Absence	1.69 ± 0.93d		26.90c	

** Data represented mean and deviation of standard; a, independent t-test (α=95%); b, data from one-way analysis of variance (α=95%)*

*** Data represented mean rank; a, Mann-Whitney U (α=95%); b, Kruskal-Wallis (α=95%)*

Gingival inflammation, as measured by the gingival index, is an early sign of abnormalities in the periodontal tissue and can be closely related to a person's systemic condition. The results showed that all respondents experienced significant gingival inflammation. Based on their hemodialysis history, the level of inflammation in respondents who underwent hemodialysis treatment was significantly higher than in those

who did not undergo hemodialysis (p<0.05). Gingival inflammation was also influenced by the duration of CKD. The longer the patient suffers from chronic kidney disease, the more severe the gingival inflammation becomes (p<0.05). Comorbidities also significantly influenced gingival inflammation (p<0.05) (Table 4).

CPITN is an index that describes the condition of periodontal health (tissue around the teeth) in a specific population and determines the need for periodontal treatment. The health status of CKD patients significantly influenced their periodontal health conditions, except for respondent's hemodialysis status (p>0.05). The duration of CKD and the presence of comorbidities significantly affected periodontal tissue health and treatment needs (p<0.05) (Table 4).

Table 5. Association of CKD and periodontal health status

Variable	CKD Status		
Periodontal health status	**Duration of CKD**	**Hemodialysis status**	**Complication**
GI	0.412**	0.561**	0.154
CPITN	0.691**	0.287	0.148
Tooth pain	-0.118	-0.295	0.000

CKD is a systemic inflammatory condition that can affect various parts of the body, including periodontal tissue. The results showed that the duration of chronic kidney disease was associated with the health status of periodontal tissue. However, hemodialysis treatment carried out by respondents was only strongly associated with gingival inflammation (3<r<1) but was not associated with the need for periodontal treatment (r<0.3). Meanwhile, the history of toothache in respondents was not associated with their status of kidney disease (r<0.3). In addition, the respondents' comorbidities were not associated with the respondents' dental and oral health (r<0.3) (Table 5).

CKD patients need periodontal treatment, whether they are undergoing hemodialysis or not, because the risk of periodontal disease progression and systemic inflammation is relatively high. CKD patients will experience xerostomia and immune system dysfunction that affects susceptibility to infection and inflammation. CKD is closely related to chronic inflammation, which can be exacerbated by inflammation in the oral cavity, such as gingivitis and periodontitis. Infection of the gums can increase the number of inflammatory mediators in the blood (such as cytokines and C-reactive protein), which can further burden the kidneys and worsen CKD. DHE, scaling, and root planing are important for CKD patients with gingivitis. They help reduce local and systemic inflammation, reduce the risk of infection, and support overall kidney health. Periodontal treatment (scaling) causes more improvement in the periodontal clinical parameters in healthy people with periodontitis than in dialysis patients (Raeesi et al., 2023).

This research has several limitations. First, a *cross-sectional* design does not make it possible to draw long-term causal conclusions. Second, behavioral variables such as frequency of brushing and smoking habits were not strictly controlled in correlation analysis. Finally, the sample size is limited to one sub-district so that the generalization of results must be done carefully on the wider population of CKD in Indonesia.

4. CONCLUSION

This study concluded that periodontal inflammation was prevalent among patients with Chronic Kidney Disease (CKD), with most participants exhibiting moderate to severe gingival inflammation and requiring periodontal treatment. The duration of CKD and the presence of comorbidities were significantly associated with the severity of gingival

inflammation and periodontal treatment needs. Furthermore, patients undergoing hemodialysis demonstrated poorer periodontal health status compared with those not receiving hemodialysis. These findings highlight the importance of integrating oral health assessment, prevention, and periodontal care into the routine management of CKD patients to reduce the risk of systemic complications and improve overall quality of life.

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REFERENCES

Adibelli, Z., & Duran, C. (2021). The compatibility of the treatment modalities to the recommendations of the kidney disease outcomes quality initiative guideline in chronic kidney disease patients with diabetes. *Iranian Journal of Public Health*, 50(6), 1206–1212. https://doi.org/10.18502/ijph.v50i6.6419

Burnier, M., & Damianaki, A. (2023). Hypertension as Cardiovascular Risk Factor in Chronic Kidney Disease. *Circulation Research*, 132(8), 1050–1063. https://doi.org/10.1161/CIRCRESAHA.122.321762

Carrero, J. J., Grams, M. E., Sang, Y., Ärnlöv, J., Gasparini, A., Matsushita, K., ... & Coresh, J. (2017). Albuminuria changes are associated with subsequent risk of end-stage renal disease and mortality. *Kidney international*, 91(1), 244-251. https://doi.org/10.1016/j.kint.2016.09.037

Chaudhry, A., Kassim, N. K., Zainuddin, S. L. A., Taib, H., Ibrahim, H. A., Ahmad, B., Hanafi, M. H., & Adnan, A. S. (2022). Potential Effects of Non-Surgical Periodontal Therapy on Periodontal Parameters, Inflammatory Markers, and Kidney Function Indicators in Chronic Kidney Disease Patients with Chronic Periodontitis. *Biomedicines*, 10(11), 1–11. https://doi.org/10.3390/biomedicines10112752

Dinas Kesehatan Kota Semarang. (2021). *Profil Kesehatan Kota Semarang 2021 [2021 Health Profile of Semarang City].* Semarang: Dinas Kesehatan Kota Semarang. Retrieved from https://dinkes.semarangkota.go.id/asset/upload/Profil/Profil%202021/FIX_Profil%20Kesehatan%202021.pdf

Francis, A., Harhay, M. N., Ong, A. C. M., Tummalapalli, S. L., Ortiz, A., Fogo, A. B., Fliser, D., Roy-Chaudhury, P., Fontana, M., Nangaku, M., Wanner, C., Malik, C., Hradsky, A., Adu, D., Bavanandan, S., Cusumano, A., Sola, L., Ulasi, I., & Jha, V. (2024). Chronic kidney disease and the global public health agenda: an international consensus. *Nature Reviews Nephrology*, 20(7), 473–485. https://doi.org/10.1038/s41581-024-00820-6

Garneata, L., Slusanschi, O., Preoteasa, E., Corbu-Stancu, A., & Mircescu, G. (2015). Periodontal Status, Inflammation, and Malnutrition in Hemodialysis Patients - Is There a Link? *Journal of Renal Nutrition*, 25(1), 67–74. https://doi.org/10.1053/j.jrn.2014.07.004

Hamza, E., Metzinger, L., & Meuth, V. M. Le. (2020). Uremic toxins affect erythropoiesis during the course of chronic kidney disease: A review. *Cells*, 9(9), 1–18. https://doi.org/10.3390/cells9092039

Kaupke, C. J., Zhang, J., Cesario, T., Yousefi, S., Akeel, N., & Vaziri, N. D. (1996). Effect of hemodialysis on leukocyte adhesion receptor expression. *American Journal of Kidney Diseases*, 27(2), 244–252. https://doi.org/10.1016/S0272-6386(96)90548-X

Kementerian Kesehatan Republik Indonesia. (2018). *Laporan Nasional RISKESDAS 2018 [2018 RISKESDAS National Report]*. Jakarta: Kementerian Kesehatan Republik Indonesia.

Kementerian Kesehatan Republik Indonesia. (2023). *Survei Kesehatan Indonesia (SKI) [Indonesian Health Survey (SKI)]*. Jakarta: Kementerian Kesehatan Republik Indonesia.

KKönigsbrügge, O., Meisel, H., Beyer, A., Schmaldienst, S., Klauser-Braun, R., Lorenz, M., ... & Ay, C. (2021). Anticoagulation use and the risk of stroke and major bleeding in patients on hemodialysis: From the VIVALDI, a population-based prospective cohort study. *Journal of Thrombosis and Haemostasis,* 19(12), 2984-2996. https://doi.org/10.1111/jth.15508

Krishnan, N., Vijay Kumar, S., Nair, A., Kavitha, R., Govind, M., & Remya, M. (2023). Oral health status of individuals affected with chronic kidney disease: A cross-sectional study. *Journal of Head and Neck Physicians and Surgeons*, 11(1), 39–43. https://doi.org/10.4103/jhnps.jhnps_98_22

Laky, M., Anscheringer, I., Wolschner, L., Heber, S., Haririan, H., Rausch-Fan, X., Volf, I., Moritz, A., & Assinger, A. (2020). Periodontal treatment does not result in detectable platelet activation in vivo. *Clinical Oral Investigations*, 24(5), 1853–1859. https://doi.org/10.1007/s00784-019-03049-x

Liakopoulos, V., Jeron, A., Shah, A., Bruder, D., Mertens, P. R., & Gorny, X. (2018). Hemodialysis-related changes in phenotypical features of monocytes. *Scientific Reports*, 8(1), 1–12. https://doi.org/10.1038/s41598-018-31889-2

Lim, K. A., & Lee, J. H. (2022). Factors Affecting Quality of Life in Patients Receiving Hemodialysis. *Iranian J Publ Health*, 51(2), 355–363. https://doi.org/10.1097/NCC.0000000000000990

Menezes, C. R. S. D., Pereira, A. L. A., Ribeiro, C. C. C., Chaves, C. O., Guerra, R. N. M., Thomaz, É. B. A. F., Monteiro-Neto, V., & Alves, C. M. C. (2019). Is There Association between Chronic Kidney Disease and Dental Caries? A Case-Controlled Study. *Medicina Oral Patologia Oral y Cirugia Bucal*, 24(2), e211–e216. https://doi.org/10.4317/medoral.22737

Nathalya Dwi, K. S., Notopuro, P. B., Hernaningsih, Y., & Widodo. (2020). Hemoglobin, Hematocrit, Leukocyte, and Platelet Changes Due To Ultrafiltrationhemodialysis in Chronic Kidney Disease Patients. *Indonesian Journal of Clinical Pathology and Medical Laboratory*, 26(3), 340–343. https://doi.org/10.24293/ijcpml.v26i3.1565

Nitta, K., Okada, K., Yanai, M., & Takahashi, S. (2014). Aging and chronic kidney disease. *Kidney and Blood Pressure Research*, 38(1), 109–120. https://doi.org/10.1159/000355760

Owlia, P., Salari, M., Saderi, H., & Kadkkoda, Z. (2000). Study of Relationship Between Depth Of Periodontal Pockets, Anaerobic Bacteria and Inflammatory Cells in Periodontitis. *Iranian J Publ Health*, *29*(1), 72–76.

Palmeira, E., Egido-Moreno, S., Omaña-Cepeda, C., Segura-Egea, J. J., & Lopez-Lopez, J. (2024). Oral manifestations in different stages of chronic kidney disease. *J Clin Med Img, 7*(21), 1-13.

Parsegian, K., Randall, D., Curtis, M., & Ioannidou, E. (2022). Association between periodontitis and chronic kidney disease. *Periodontology 2000*, 89(1), 114–124. https://doi.org/10.1111/prd.12431

Raeesi, V., Mohammadi Moghaddam, M., Naghavi, A., & Mozafari, G. (2023). The effect of scaling and root planning on the periodontal condition in hemodialysis patients: A clinical trial study. *Health Science Reports*, 6(8). https://doi.org/10.1002/hsr2.1520

Ruokonen, H., Nylund, K., Meurman, J. H., Heikkinen, A. M., Furuholm, J., Sorsa, T., Roine, R., & Ortiz, F. (2019). Oral symptoms and oral health-related quality of life in patients with chronic kidney disease from predialysis to posttransplantation. *Clinical Oral Investigations*, 23(5), 2207–2213. https://doi.org/10.1007/s00784-018-2647-z

Tawfig, A., Jamal, B., Eskandrani, R., AlDayel, L., AlTwaijry, S., AlGhamdi, E., & Ahmed, B. (2016). Assessment of Periodontal Disease Severity among Patients at Different Stages of Chronic Kidney Disease. *Journal of International Oral Health*, 8(3), 307–312. https://doi.org/10.2047/jioh-08-03-02

Vladu, I. M., Cojan, T. S. T., Demetrian, A., Cristea, O. M., Ene, C. G., & Clenciu, D. (2019). The presence of chronic kidney disease in relation to age and duration of diabetes mellitus. *Revista de Chimie*, 70(4), 1471–1475. https://doi.org/10.37358/rc.19.4.7151

Wirnsberger, G. (2018). *Kidney Disease in Old Age. In Learning Geriatric Medicine: A Study Guide for Medical Students (pp. 151-159).* Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-61997-2_16