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The Relationship between Hemodialysis Frequency and Electrolyte Levels in Patients with Chronic Kidney Disease

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Abstract

Chronic kidney disease (CKD) is a growing global health problem that often requires renal replacement therapy in the form of hemodialysis. Electrolyte imbalances, particularly abnormalities in sodium, potassium, and chloride levels, are commonly found in patients with CKD and can lead to serious complications. The frequency of hemodialysis is considered an important factor in maintaining electrolyte balance; however, previous studies have reported inconsistent findings. This study is an analytical observational study with a cross-sectional design. Data were collected from the medical records of CKD patients undergoing routine hemodialysis at Bakti Timah Hospital, Pangkalpinang, between September 2025 and February 2026. A total of 55 subjects were selected using a consecutive sampling technique based on the inclusion and exclusion criteria. The independent variable was hemodialysis frequency, while the dependent variables were serum sodium, potassium, and chloride levels. Data were analyzed using Spearman's correlation test with a significance level of $p<0.05$. The median hemodialysis frequency over six months was 47 sessions. The median serum sodium, potassium, and chloride levels were 138 mmol/L, 4.6 mmol/L, and 105 mmol/L, respectively. Statistical analysis showed no significant correlation between hemodialysis frequency and sodium levels ($r=-0.131$; $p=0.341$), potassium levels ($r=0.080$; $p=0.561$), or chloride levels ($r=-0.113$; $p=0.411$). Hemodialysis frequency was not significantly associated with serum sodium, potassium, or chloride levels in patients with chronic kidney disease undergoing routine hemodialysis.

Keywords: Chloride, Chronic kidney disease, Hemodialysis frequency, Potassium, Sodium

1. Introduction

Chronic kidney disease (CKD) is a growing global health concern characterized by a progressive and irreversible decline in kidney function lasting for more than three months, with or without a reduced glomerular filtration rate.[1,2] In 2023, an estimated 788 million adults aged 20 years and older were living with CKD worldwide, corresponding to a global age-standardized prevalence of 14.2% among adults, an increase from 378 million cases in 1990.[3] In Indonesia, the prevalence of CKD was reported at 0.38% in the 2018 Basic Health Research (Riskesdas) and 0.18% in the 2023 Indonesian Health Survey (SKI). In advanced stages, hemodialysis is the primary renal replacement therapy used to remove metabolic waste products and maintain fluid and electrolyte balance[4,5] Nevertheless, electrolyte disturbances, particularly involving sodium, potassium, and chloride, remain common among patients undergoing hemodialysis due to the progressive loss of residual kidney function. These imbalances may lead to serious complications, including cardiac arrhythmias, seizures, blood pressure abnormalities, and increased mortality.[6,7]

Hemodialysis frequency is thought to play an important role in maintaining electrolyte homeostasis; however, existing evidence remains inconsistent. Anwar et al. reported significant changes in serum sodium, potassium, and chloride levels before and after hemodialysis ($p<0.001$),[8] while Alaswad et al. found no significant changes in sodium and chloride levels under similar conditions.[9] Although both studies compared electrolyte levels before and after hemodialysis within a

single session, neither evaluated the relationship between cumulative hemodialysis frequency and electrolyte changes, highlighting a significant gap in the current scientific evidence." Unlike a single-session comparison, cumulative dialysis exposure reflects the sustained, longer-term adequacy of solute removal and may better represent a patient's overall electrolyte trajectory over time; whether this cumulative exposure is associated with post-dialysis electrolyte status, independent of any single session, therefore remains an unanswered and clinically relevant question, particularly for informing how dialysis attendance is monitored over time.

This paper aimed to evaluate the association between hemodialysis frequency and serum electrolyte levels (sodium, potassium, and chloride) in patients with chronic kidney disease undergoing maintenance hemodialysis, in order to provide preliminary evidence regarding the association between cumulative dialysis exposure and post-dialysis electrolyte levels. These findings may contribute to the current evidence base and inform clinical decision-making and patient education.

2. Method

This analytical observational study employed a cross-sectional design and was conducted at Bakti Timah Hospital, Pangkalpinang. Medical records of patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis between September 1, 2025, and February 22, 2026, were reviewed, with data collected from February 20–25, 2026.

This research has been approved by the Health Research Ethics Committee, Faculty of Medicine, Trisakti University, Jakarta, Indonesia (Ethics Approval Number: 003/KER/FK/02/2026).

Participants were recruited using consecutive sampling. Eligible subjects were CKD patients receiving maintenance hemodialysis with complete post-dialysis serum electrolyte data. Patients undergoing emergency hemodialysis or receiving medications known to affect electrolyte levels, including angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, or diuretics, were excluded. The minimum sample size of 55 participants, including a 15% reserve to account for potential dropouts, has been met.

The independent variable was hemodialysis frequency, defined as the cumulative number of completed hemodialysis sessions over six months. All participants were prescribed a twice-weekly maintenance hemodialysis regimen; the frequency variable therefore reflects treatment attendance (the actual number of completed sessions relative to the prescribed schedule) rather than variation in the prescribed dialysis regimen itself. "The dependent variables were post-dialysis serum sodium, potassium, and chloride levels, measured using the ion-selective electrode (ISE) method according to standard reference ranges." For each patient, the electrolyte value analyzed was the result obtained immediately after the most recent hemodialysis session within the six-month study period, as recorded in the medical record.[10,11]

Data normality was assessed using the Kolmogorov–Smirnov test. As all variables were non-normally distributed ($p<0.05$), associations were analyzed using Spearman's rank correlation with a significance level of $p<0.05$ in SPSS for Mac version 30.

Table 1. Baseline Characteristics of the Study

Variable	Distribution (N = 55) Median (Min-Max)
Age	56 (46-70)
Body mass index (kg/m^2)	22.59 (20-25.82)
Sex (N (%))	
Male	34 (61.8 %)
Female	21 (38.2 %)
Hemodialysis frequency	47 (40-48)
Serum Sodium (mmol/L)	138 (124-155)
Serum Potassium (mmol/L)	4.6 (2.7-9)
Serum chloride (mmol/L)	105 (98-123)

Table 2. Correlation between Hemodialysis Frequency and Serum Electrolyte Levels

Variable	Correlation coefficient (r)	Value (*p*)
Hemodialysis frequency vs. serum sodium	-0.131	0.341
Hemodialysis frequency vs. serum potassium	0.08	0.561
Hemodialysis frequency vs. serum chloride	-0.113	0.411

*Spearman's rank correlation test; statistical significance was defined as p<0.05

3. Result

A total of 55 patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis met the study eligibility criteria.

Based on table one, most participants were male (61.8%), with a median age of 56 years and a median body mass index of 22.59 kg/m². The median hemodialysis frequency during the six-month study period was 47 sessions, corresponding to approximately two sessions per week. The median post-dialysis serum sodium, potassium, and chloride levels were 138 mmol/L, 4.6 mmol/L, and 105 mmol/L, respectively.

Therefore, based on table two, no significant correlation was found between hemodialysis frequency and serum sodium (r = −0.131, p = 0.341), potassium (r = 0.080, p = 0.561), or chloride levels (r = −0.113, p = 0.411).

4. Discussion

The main finding of this study was that cumulative hemodialysis frequency over a six-month period was not significantly associated with post-dialysis serum sodium, potassium, or chloride levels among patients with chronic kidney disease undergoing maintenance hemodialysis.

Sodium, potassium, and chloride are the principal extracellular electrolytes responsible for maintaining osmotic balance, fluid volume, nerve impulse transmission, and acid–base homeostasis.[12] In the present study, no significant association was found between hemodialysis frequency and serum sodium levels (r = −0.131, p = 0.341). This finding is consistent with Tambajong et al., who suggested that sodium balance in patients with CKD is primarily influenced by dietary sodium and fluid intake, as well as dialysate sodium concentration, rather than dialysis frequency.[13] Similarly, no correlation was observed between hemodialysis frequency and serum chloride levels (r = −0.113, p = 0.411). Because chloride closely follows sodium to maintain electrical neutrality, its concentration is largely determined by the relatively uniform dialysate composition used within a dialysis center. A comparable finding was reported by Widiyawati et al., who found no association

between hemodialysis frequency and serum creatinine levels.[14]

Likewise, serum potassium levels were not significantly associated with hemodialysis frequency ($r = 0.080$, $p = 0.561$). Choi et al. reported that potassium homeostasis is influenced mainly by dietary potassium intake and residual kidney function rather than dialysis frequency alone,[15] consistent with the findings of Azridani et al. in patients receiving maintenance hemodialysis.[16] The absence of a significant correlation in this study may be explained by the relatively narrow range of hemodialysis frequency (40–48 sessions over six months, approximately twice weekly). Previous studies by Aoun et al. and Dai et al., which compared twice- versus three-times-weekly hemodialysis, demonstrated significant differences in serum potassium levels and clinical outcomes.[17,18] Similarly, Sachan et al. reported that higher dialysis frequency was associated with more stable electrolyte control, suggesting that a wider variation in dialysis frequency may be required to detect a significant association.[19]

With respect to baseline characteristics, the median age of participants was 56 years[20], consistent with the age range reported among patients with CKD undergoing hemodialysis by Prasetya et al. and Saragih et al.[21,22] and in line with the progressive decline in functional nephron number associated with aging. Male participants predominated (61.8%); previous studies have attributed male predominance among CKD patients to greater exposure to lifestyle-related risk factors and nephrotoxic agents[23], but as these factors were not directly assessed in the present study, this explanation should be regarded as speculative rather than confirmed. The median body mass index was 22.59 kg/m² (range: 20–25.82 kg/m²), which falls within the normal to upper-normal range according to the Asia-Pacific BMI classification.

Clinically, these findings suggest that dialysis attendance or frequency alone may not be a reliable indicator of electrolyte stability in patients undergoing maintenance hemodialysis. Rather than relying on session count as a proxy for adequate electrolyte control, clinicians may need to place greater emphasis on individualized monitoring that incorporates dietary intake, interdialytic weight gain, and residual kidney function when assessing a patient's electrolyte status.

This study has several limitations. First, the cross-sectional design precludes any causal or temporal inference between hemodialysis frequency and electrolyte levels. Second, the relatively narrow range of observed hemodialysis frequency (40–48 sessions over six months) may have limited the ability to detect an association that could emerge across a wider range of dialysis exposure, such as a comparison between twice- and three-times-weekly regimens. Third, other determinants of electrolyte homeostasis, including dietary intake, interdialytic weight gain, residual kidney function, and comorbidities, were not measured or adjusted for in this analysis. Finally, this was a single-center study, which may limit the generalizability of the findings to other populations and clinical settings.

Future studies with a longitudinal design, a wider range of prescribed dialysis frequencies, and adjustment for dietary and residual renal function covariates are needed to further clarify the relationship between hemodialysis frequency and electrolyte homeostasis.

5. Conclusion

Within the limited range of cumulative hemodialysis sessions observed in this study, no statistically significant correlation was identified between the number of hemodialysis sessions and post-dialysis serum sodium, potassium, or chloride levels. These

findings should be interpreted cautiously because of the limited variability in dialysis exposure and the absence of adjustment for major determinants of electrolyte homeostasis. These observations suggest that electrolyte levels are most likely influenced by other factors, including dietary intake, weight gain between dialysis sessions, and residual kidney function.

6. Acknowledgement

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References

1. Foundation Nk, Daugirdas Jt, Depner Ta, Inrig J, Mehrotra R, Rocco M V, et al. Kdoqi Clinical Practice Guideline For Hemodialysis Adequacy: 2015 Update. American Journal Of Kidney Diseases. 2015 Nov 1;66(5):884–930. Doi: 10.1053/J.Ajkd.2015.07.015
2. Aru Wisaksono Sudoyo, Bambang Setiyohadi, Idurs Alwi, Marcellus Simadibrata Kolopaking, Siti Setiati. Buku Ajar Ilmu Penyakit Dalam Jil. III Ed. V [Internet]. 5th Ed. 2009. Doi:10.1016/S0140-6736(25)01853-7.
3. GBD 2023 Chronic Kidney Disease Collaborators. Global, Regional, And National Burden Of Chronic Kidney Disease In Adults, 1990-2023, And Its Attributable Risk Factors: A Systematic Analysis For The Global Burden Of Disease Study 2023. Lancet. 2025 Nov 22;406(10518):2461–82. Doi:10.1016/S0140-6736(25)01853-7.
4. Tim Riskesdas 2018. Laporan Riskesdas 2018 Nasional. Jakarta; 2019.
5. Kementerian Kesehatan Republik Indonesia. Survei Kesehatan Indonesia (Ski) 2023 [Internet]. Jakarta; 2023.
6. Rahmawati F. Aspek Laboratorium Gagal Ginjal Kronik. Jurnal Ilmiah Kedokteran Wijaya Kusuma. 2018 Mar 2;6(1):14. DOI: 10.30742/Jikw.V6i1.323
7. Kusuma Da, Samsuria Ik. Hubungan Kadar Kreatinin Serum Dengan Kadar Mineral Pada Pasien Chronic Kidney Disease. Medica Hospitalia: Journal Of Clinical Medicine. 2020 Nov 19;7(2):393–7. Doi: 10.36408/Mhjcm.V7i2.510
8. Anwar S, Ariosta A. Perbedaan Kadar Ureum, Natrium, Kalium Dan Klorida Pra Dan Pasca Hemodialisis Pada Pasien Dengan Penyakit Ginjal Kronik. Intisari Sains Medis. 2019 Apr 1;10(1). Doi:Https://Doi.Org/10.15562/Ism.V10i1.346
9. Najat Alaswad, Manal Khalifa. Serum Electrolyte Changes In Chronic Renal Failure Pre- and Post-Dialysis. Alqalam Journal Of Medical And Applied Sciences. 2025 Mar 30;47–50. Doi:Https://Doi.Org/10.54361/Ajmas.258108
10. Yaswir R, Ferawati I. Fisiologi Dan Gangguan Keseimbangan Natrium, Kalium Dan Klorida Serta Pemeriksaan Laboratorium. Jurnal Kesehatan Andalas. 2012 Sep 1;1(2). Doi:Https://Doi.Org/10.25077/Jka.V1i2.48
11. Suryani L, Yurman Y, Hepiyansori H, Jais A. Gambaran Kadar Natrium, Kalium Dan Klorida Darah Penderita Hipertensi Di Rsud Dr. M. Yunus Bengkulu. Jurnal Medika. 2025 Jul 6;10(1):12–7. DOI: Https://Doi.Org/10.53861/Jmed.V10i1.594
12. Hall Je., Guyton Ac. Guyton And Hall Textbook Of Medical Physiology. 12th Ed. Saunders/Elsevier; 2011. 1091 P.
13. Tambajong Ry, Rambert Gi, Wowor Mf. Gambaran Kadar Natrium Dan Klorida Pada Pasien Penyakit Ginjal Kronik Stadium 5 Non-Dialisis. Vol. 4, Jurnal E-Biomedik (EBM). 2016. Doi:Https://Doi.Org/10.35790/Ebm.V4i1.12200
14. Agatha Widiyawati, Aulya Wura Rahmanda. Hubungan Asupan Protein Dan Frekuensi Hemodialisis Dengan Kadar Serum Kreatinin Pada Pasien Gagal Ginjal Kronik Di Rumah Sakit Umum Kaliwates. Harena: Jurnal Gizi. 2025 Apr 26;5(2):97–103. . Doi:Https://Doi.Org/10.25047/Harena.V5i2.5981
15. Choi Hy, Ha Sk. Potassium Balances In Maintenance Hemodialysis. Electrolytes &

Blood Pressure. 2013;11(1):9. DOI: 10.5049/Ebp.2013.11.1.9

16. Azridani Na, Halil F, Darmayanti D. Gambaran Elektrolit Pasien Penyakit Ginjal Kronik Dengan Hemodialisa Di Rsud Dr H. Chasan Boesoirie. Mutiara: Multidisciplinary Scientific Journal. 2025 Apr 30;3(4):370–8. Https://Doi.Org/10.57185/Mutiara.V3i4.361
17. Aoun M, Finianos S, Beaini C, Sleilaty G, Ghaleb R, Nourie N, Et Al. Twice Against Thrice-Weekly Hemodialysis (Tath): A Multicenter Nonrandomized Trial. BMC Nephrol. 2025 Apr 5;26(1):176. DOI: 10.1186/S12882-025-04105-3.
18. Dai L, Lu C, Liu J, Li S, Jin H, Chen F, Et Al. Impact Of Twice- Or Three-Times-Weekly Maintenance Hemodialysis On Patient Outcomes: A Multicenter Randomized Trial. Medicine. 2020 May 15;99(20):E20202. DOI: 10.1097/Md.0000000000020202.
19. Sachan P, Jagtap S, Kumthekar G, Bhanap P, Sagar TV. Comparison Of Different Hemodialysis Frequencies Per Week On Adequacy Parameters Including Electrolytes In Patients On Chronic Hemodialysis. National Board Of Examinations Journal Of Medical Sciences. 2024;2(8):791–802. Doi: 10.61770/Nbejms.2024.V02.I08.004
20. Arriyani F, Wahyono Tym. Faktor Risiko Penyakit Ginjal Kronis Pada Kelompok Usia Dewasa: Literature Review. Media Publikasi Promosi Kesehatan Indonesia (Mppki). 2023 May 8;6(5):788–97. DOI: Https://Doi.Org/10.56338/Mppki.V6i5.3239
21. Prasetya Dct, Pateda Sm, Ihsan M, Yusuf Mns, Antu Y. Karakteristik Dan Komorbiditas Pasien Gagal Ginjal Kronis. Jurnal Keperawatan Tropis Papua. 2024 Dec 30;7(2):147–54. Doi:Https://Doi.Org/10.47539/Jktp.V7i2.415
22. Saragih Sri; Yuniarti, Rafita; Indrayani, Gabena; Peri, Peri Amw. Gambaran Karakteristik Pasien Gagal Ginjal Kronis Stadium V Yang Menjalani Hemodialisis. Scientica: Jurnal Ilmiah Sains Dan Teknologi. 2024;(Vol. 3 No. 1 (2024): Scientica: Jurnal Ilmiah Sains Dan Teknologi):431–40.
23. Abyuta Wiksa Pranandhira R, Yudha Rahman E, Khatimah H. Karakteristik Pasien Chronic Kidney Disease Yang Dilakukan Hemodialisis Di Rsud Ulin Banjarmasin Selama Pandemi Covid-19 Tinjauan Terhadap Usia, Jenis Kelamin, Pendidikan, Pekerjaan, Status Pernikahan, Riwayat Penyakit Penyerta, Riwayat Terpajan Virus Covid-19. Homeostasis. 2023 May 23;6(1):69. Doi:Https://Doi.Org/10.35790/Ebm.V4i1.12200