

Original Research Article

Kt/V and its association with nutritional status and quality of life in end-stage renal disease patients: a cross-sectional multivariate study

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ABSTRACT

Background: Dialysis adequacy assessed by Kt/V is a key predictor of outcomes in end-stage renal disease (ESRD). However, its relationship with nutritional status and health-related quality of life (HRQoL) remains unclear in low-resource, single-center settings.

Methods: A cross-sectional study was conducted on 65 ESRD patients receiving maintenance haemodialysis (HD) at Wangaya Hospital. Dialysis adequacy was evaluated using single-pool Kt/V. Nutritional status was assessed using BMI and Malnutrition Inflammation Score (MIS), and HRQoL was measured using KDQOL-36. Bivariate and multivariate logistic regression analyses were performed.

Results: A total of 70.8% of patients achieved adequate dialysis ($Kt/V \geq 1.2$). Adequacy was significantly associated with BMI ($p=0.024$), but not with MIS. Among HRQoL domains, only the physical component summary showed a significant association with dialysis adequacy ($p=0.014$). Multivariate analysis identified employment status and serum albumin as independent predictors of quality of life and nutritional status. Low TIBC and female gender were associated with impaired mental health and higher malnutrition risk.

Conclusion: Kt/V-based dialysis adequacy correlates with improved physical functioning and BMI, though not all HRQoL aspects. Findings may support further multicentre research on adequacy and patient outcomes in resource-limited settings.

Keywords: Kt/V, End-stage renal disease, Nutritional status, Quality of life, Haemodialysis

INTRODUCTION

Chronic kidney disease (CKD) is a condition characterized by structural or functional abnormalities of the kidney, lasting for more than or equal to 3 months, and can affect health conditions.¹

Haemodialysis (HD) is a kidney replacement therapy primarily for patients with chronic kidney disease stage 5 (CKD stage 5D). This therapy aims to remove excess uremic toxins, electrolytes, and excess metabolic waste that cannot be excreted by the kidneys.² The adequacy of the HD process is assessed by Kt/V. The Kt/V value differs for each patient, so Kt/V is needed as a determinant for the frequency and duration of a single HD session.³ It is known

that the morbidity and mortality of dialysis patients can be reduced by improving the adequacy of dialysis and other factors. Many factors can affect the quality of life of HD patients. Factors that affect the quality of life of HD patients include age, gender, etiology of CKD, nutritional status, comorbid conditions, education, occupation, duration of HD, and medical management.

Achieving an adequate HD dose is important to maintain optimal conditions and improve the quality of life of patients. Additionally, evaluating HD adequacy is difficult due to many factors, such as volume status, electrolytes, and acid-base balance that interfere with it, but Kt/V is often used and can be utilized as a parameter. Several studies have suggested that patients who achieve HD

adequacy have a better quality of life compared to patients who do not achieve HD adequacy.⁴⁻⁶ Research by Siswandi et al shows that patients with good nutritional status have a better quality of life than those with poor nutritional status.^{7,8}

Nutrient status is determined by estimating the individual's body mass index (BMI) after HD. Finding a BMI that is too high, normal, or low can reveal an individual's mortality and morbidity.

Nutrient intake is impacted by urea and cytokine toxicity, which causes inflammation and anorexia. It is crucial to improve the nutritional status and quality of life of patients who undergo HD.⁸⁻¹⁰

METHODS

This cross-sectional study was conducted at Wangaya General Hospital, Denpasar, from December 2024 to January 2025, involving 65 ESRD patients undergoing regular hemodialysis (2–3 sessions/week for ≥3 months). Participants were selected using consecutive sampling. Patients with peritoneal dialysis, acute kidney injury, pregnancy, or severe comorbidities were excluded.

Dialysis adequacy was measured using single-pool Kt/V, nutritional status via BMI and Malnutrition Inflammation Score (MIS), and quality of life using the KDQOL-36 instrument. Variables such as age, sex, employment, albumin, and TIBC were included as covariates.

Statistical analyses (Chi-square and logistic regression) were performed using SPSS, with significance set at

$p < 0.05$. Data were analyzed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA).

The sample size was deemed sufficient for exploratory multivariate analysis, adhering to the minimum recommended events-per-variable ratio to avoid model overfitting.

RESULTS

A total of 65 patients in Table 1 with CKD stage 5D undergoing regular HD met the inclusion criteria, with a mean age of 53.4 ± 13.2 years.

The majority of patients were female (58.5%), had a high level of education (70.8%), and were unemployed (60.0%). Most patients achieved adequate HD (70.8%) with a mean Kt/V of 1.3 ± 0.2 . Regarding nutritional status, 52.3% had no malnutrition based on MIS with a mean score of 8.4 ± 3.1 , while 64.6% had a normal BMI with a mean of 23.5 ± 4.3 kg/m².

Associations between HD adequacy, quality of life domains, and nutritional status are summarized in Table 2. Adequate HD was significantly associated with better outcomes in the physical composite domain ($p = 0.014$) and normal BMI ($p = 0.024$).

Multivariable logistic regression in Table 3 identified female gender as an independent predictor of poorer mental health outcomes ($p = 0.037$), while employment status and serum albumin were associated with burden of kidney disease ($p = 0.023$ and $p = 0.025$, respectively). Higher TIBC levels were protective against malnutrition ($p = 0.034$).

Table 1: Participant characteristics (n=65).

Characteristic	Category	N (%)	Mean±SD
Gender	Female	38 (58.5%)	53.4±13.2 years
	Male	27 (41.5%)	
Age (in years)	18-29	6 (9.2%)	53.4±13.2 years
	30-49	21 (32.3%)	
	50-64	25 (38.5%)	
	≥65	13 (20.0%)	
Education	Low	19 (29.2%)	46 (70.8%)
	High	46 (70.8%)	
Employment status	Employed	26 (40.0%)	39 (60.0%)
	Unemployed	39 (60.0%)	
Haemodialysis adequacy (Kt/V)	Adequate (≥1.2)	46 (70.8%)	1.3±0.2
	Inadequate (<1.2)	19 (29.2%)	
Nutritional status (MIS)	Without Malnutrition	34 (52.3%)	8.4±3.1
	Malnutrition	31 (47.7%)	
Nutritional status (BMI)	Normal	42 (64.6%)	23.5±4.3 kg/m ²
	Overweight	18 (27.7%)	
	Obese	3 (4.6%)	
	Underweight	2 (3.1%)	

Table 2. Association between hemodialysis adequacy and quality of life/nutritional status.

Variable	Adequate (n=46)	Inadequate (n=19)	P value
Symptoms and problem list (good)	42 (91.3%)	14 (73.7%)	0.061
Effects of kidney disease (good)	40 (87.0%)	13 (68.4%)	0.080
Burden of kidney disease (good)	29 (63.0%)	7 (36.8%)	0.053
Physical composite (good)	12 (26.1%)	0 (0%)	0.014*
Mental composite (good)	34 (73.9%)	12 (63.2%)	0.386
Nutritional status (MIS-without malnutrition)	23 (50.0%)	11 (57.9%)	0.562
Nutritional status (BMI-normal)	35 (76.1%)	7 (36.8%)	0.024*

Note: *p< 0.05 indicates statistical significance.

Table 3: Multivariate logistic regression analysis.

Variable	HR	95% CI	P value
Female gender (Mental composite)	3.398	1.089-14.233	0.037*
Employment status (Burden of disease)	4.059	1.208 – 13.977	0.023*
Albumin <4.0 g/dl (Malnutrition)	4.089	1.196 – 13.997	0.025*
TIBC <250 mg/dl (Malnutrition)	0.265	0.078 – 0.904	0.034*

Note: HR = Hazard Ratio; CI=Confidence Interval; *p <0.05 indicates statistical significance.

DISCUSSION

According to the findings of the Kt/V-based study on HD adequacy measurement, more patients (70.8%) attained HD adequacy than those who did not (29.2%). For HD three times a week for four hours each, and HD two times a week for four to five hours each, the PERNEFRI consensus optimum Kt/V is 1.2 (URR 65%), for a weekly total of ten to fifteen hours. KDIGO (kidney disease: improving global outcome) 2015, cited in PNPk chronic kidney disease management 2023, suggests that routine HD patients have a single pool Kt/V of 1.2–1.4 each session, three times per week. Patients who do not take HD twice a week are advised to take 2.1–2.3 doses.³

The study found that the average spKT/V value was 1.3 when HD was performed twice a week for six hours each session. KT/V value showed that 70.8% of patients met the KDOQI-recommended KT/V >1.2 criterion for HD adequacy.^{19,20} Still, the dialysis adequacy standard takes into account weekly clearance (stdKT/V), which in a twice-weekly regimen tends to be lower than three-times-weekly HD, even when the KT/V number per session suggests acceptable urea clearance efficiency.¹¹

Thus, these findings imply that for long-term dialysis adequacy, additional assessment of uremic toxin accumulation, patient clinical status, and potential risk of uremia between sessions is still required, even though the majority of patients in this study achieved adequacy based on KT/V per session. Institutions can employ several strategic measures to increase HD adequacy for patients who have fallen short of the goal. One of the primary tasks is to assess the frequency and length of HD. Patients with low KT/V may benefit from increasing the frequency to three times per week or extending the length of each session to maximize urea clearance. The efficacy of

treatment can also be increased by choosing a dialyzer with a greater urea transfer coefficient (CoA) and making sure that dialyzer reuse efficiency is high. For the best HD efficiency, it's also critical to optimize dialysate flow (Qd) of at least 500–800 mL/min and blood flow (Qb) of at least 300–400 mL/min. Furthermore, regular vascular access monitoring is necessary to detect and manage thrombosis or stenosis that may impede blood flow throughout the treatment.

In terms of education, patients should be taught about fluid control, a low-uraemia diet, and following the HD schedule to avoid an increase in the urea distribution volume that could lower KT/V. Standardizing post-HD blood collection protocols is equally crucial. This includes making sure that samples are collected 30 to 60 minutes following an HD session to prevent urea rebound from distorting KT/V estimations. These regulations allow facilities to increase the adequacy of HD, which eventually helps patients live better lives.^{12,13}

In contrast to the study by Prabhaswari et al, which assessed overall quality of life without detailing its components, our study specifically analyzed the relationship between dialysis adequacy (Kt/V) and the five components of quality of life. We found that among respondents who achieved adequacy, 12 demonstrated good quality of life based on the physical component summary (PCS), while 19 respondents with inadequate dialysis showed poor physical quality of life. A significant association was observed between dialysis adequacy and the PCS (p=0.014). In the KDQOL-36, the PCS reflects key domains of physical health, including physical functioning, role limitations due to physical problems, bodily pain, and general health perception.¹³ The PCS score reflects the impact of physical health on daily activities, perceived pain levels, and overall health

perception in CKD patients, with higher scores indicating better physical quality of life.¹⁴ A 2022 study at RSU royal prima medan reported that 60% of 25 patients had good quality of life, with a significant association between HD adequacy (Kt/V) and quality of life ($p=0.000$).¹⁵ Similarly, Hasan et al. demonstrated that patients with higher dialysis adequacy ($Kt/V > 1.5$) had significantly better physical composite scores compared to those with lower adequacy ($Kt/V < 1.2$; $p = 0.001$). Significant differences were also observed between $Kt/V > 1.5$ and $1.2-1.5$ ($p=0.042$), while no significant difference was noted between $Kt/V 1.2-1.5$ and <1.2 ($p=0.129$). These findings suggest that higher dialysis adequacy, particularly $Kt/V > 1.5$, is associated with improved physical quality of life.¹³⁻¹⁵

This study found no significant association between HD adequacy, measured by Kt/V, and nutritional status assessed by the Malnutrition Inflammation Score (MIS) ($p=0.562$). Among patients with adequate Kt/V, 23 experienced malnutrition and 23 did not, while among those with inadequate Kt/V, 8 experienced malnutrition and 11 did not. These findings suggest that HD adequacy alone does not directly correlate with nutritional status when assessed clinically via MIS. Nutritional status in HD patients is multifactorial, influenced by systemic inflammation, comorbidities, and daily intake, beyond urea clearance efficiency. Kalantar-Zadeh et al highlighted that Protein Energy Wasting (PEW) is predominantly driven by systemic inflammation rather than dialysis adequacy. Given that MIS reflects both nutritional and inflammatory states, discrepancies with Kt/V measurements are expected in the presence of inflammatory or other metabolic disturbances.¹⁶

In contrast to MIS findings, nutritional status assessed by body mass index (BMI) showed a significant association with dialysis adequacy ($p=0.024$). Among patients with adequate Kt/V, 64.6% had normal BMI and 27.7% were overweight, with few categorized as underweight or obese. This suggests that better Kt/V values correlate with improved anthropometric status. These results align with Hong et al, who reported that low BMI is associated with higher uremic toxin levels and increased malnutrition risk, even in patients with technically adequate Kt/V.¹⁹

However, adequate Kt/V alone is insufficient to optimize nutritional status without appropriate nutritional support and inflammation management. Additionally, BMI, being influenced by dry weight, fluid shifts, and muscle mass, is more sensitive to short-term changes post-HD, whereas MIS reflects broader, slower-changing aspects of nutrition and inflammation.^{20,21}

In this study, regression analysis showed that gender was not independently associated with symptoms and disease burden in CKD patients undergoing maintenance HD (HR 4.943; 95% CI 0.774–31.570; $p=0.091$). This suggests that gender-related differences in QoL are likely influenced by social, psychosocial, and role-related factors rather than biological gender alone. Tamura et al reported that women

on HD often experience lower QoL, partly due to greater caregiving responsibilities, and proposed that individualized approaches, such as incremental HD, may mitigate these effects. Similarly, a study by Pratiwi et al in Indonesia identified multiple factors influencing QoL, including age, education, income, stress levels, and social support, with male gender associated with better QoL largely through social and economic mediators.²¹

Albumin levels <4.0 g/dL were identified as a significant predictor, associated with a 4.089-fold increased risk of greater kidney disease burden. Hypoalbuminemia in HD patients, often reflecting malnutrition and chronic inflammation, is linked to poorer quality of life. Soleymanian et al reported that low serum albumin correlates with reduced QoL scores, while Elsherbiny et al. (2024) further confirmed its association with impaired QoL and higher mortality risk in this population.²²

Based on the results of the regression analysis in the study, it was found that female respondents with CKD who underwent routine HD had a 3,398 times higher risk of declining mental health and psychological well-being compared to male patients. This finding is in line with several studies in the last five years. Research by Riehl-Tonm et al showed that women undergoing HD reported a lower quality of life than men, especially in the mental health domain.

This may be due to biological factors, such as differences in body composition that affect HD doses, as well as gender factors, such as greater domestic responsibilities and caregiver roles in women.²⁰ In addition, a study by Masià-Plana et al, highlighted that emotional intelligence plays an important role in the quality of life of HD patients, with significant differences based on gender.²³ Women showed higher emotional intelligence scores, which may affect their perceptions of quality of life and psychological well-being.²³ Another study by Nadort et al, during the COVID-19 pandemic found that HD patients experiencing COVID-19 related stress had lower mental health scores, with women showing higher susceptibility to stress and depression.²⁴

The findings in this study indicate that albumin levels ≥ 4.0 g/dl and mean TIBC ≥ 250 mg/dl have a significant protective relationship against malnutrition in CKD patients undergoing routine HD. These results are consistent with previous theories and studies stating that higher albumin levels reflect better nutritional status and are associated with better prognosis. Albumin is an indicator of nutritional status and inflammation that has long been used in the clinical assessment of HD patients.

Patients with albumin levels <4.0 g/dl tend to experience malnutrition-inflammation-atherosclerosis (MIA) syndrome, while patients with level ≥ 4.0 g/dl tend to have better nutritional status and lower risk of mortality.^{25,26} In addition, total iron binding capacity (TIBC) is also a marker of protein synthesis and nutritional status. A low

TIBC value usually indicates chronic inflammation or nutritional deficiency, while a higher TIBC value, namely ≥ 250 mg/dl, indicates better liver protein synthesis capacity and adequate nutritional status.¹⁶

This study has several limitations. Its cross-sectional design does not allow causal conclusions, and the modest sample size from a single center may limit generalizability. Additionally, the use of self-reported questionnaires may be subject to bias. Nevertheless, the findings offer preliminary insight into the relationship between dialysis adequacy, nutritional status, and quality of life, and may inform larger prospective or multicentre studies.

CONCLUSION

This study found that most ESRD patients undergoing maintenance haemodialysis at Wangaya Hospital achieved adequate dialysis as measured by Kt/V. Adequacy was significantly associated with better physical quality of life and nutritional status (BMI), though not with MIS. Employment status, serum albumin, female gender, and TIBC were identified as significant predictors of quality of life and nutritional risk. These findings highlight the need to optimize dialysis adequacy and consider individual sociodemographic and biochemical factors to improve patient outcomes.

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REFERENCES

- Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2024 clinical practice guideline for the evaluation and management of chronic kidney disease. *Kidney Int.* 2024;105(4):117–4.
- Indonesian Nephrology Association. Dialysis consensus. 1st ed. Vol. 1. Jakarta: PERNEFRI; 2003. Available at: <https://www.pernefri.org>. Accessed on 12 December 2024.
- Ministry of Health of the Republic of Indonesia. National Clinical Practice Guideline (PNPK): Management of Chronic Kidney Disease. No. HK.01.07/MENKES/1634/2023. Jakarta: Ministry of Health of the Republic of Indonesia; 2023. Available at: <https://www.kemkes.go>. Accessed on 12 December 2025.
- Solihatin Y, Rahmawati A, Susilawati S. Association between hemodialysis adequacy and quality of life in hemodialysis patients at the Hemodialysis Unit of Jasa Kartini Hospital, Tasikmalaya. *Health Care Nurs J.* 2019;2:55-9.
- Alasta L, Halizasia G, Riansyah F. Factors that influence the adequacy of dialysis in patients undergoing dialysis therapy at the Hemodialysis Installation of Hospital Dr. Zainoel Abidin in 2023. *ICONESTH.* 2023;1;85–92.
- AI-Rubaia ZR, AI-Ashour IA, AI-Mubarak ZA. View of association between dialysis adequacy and quality of life among haemodialysis patients. *J Pos School Psychol.* 2022;2:1486-95.
- Hasan LM, Shaheen DAH, El Kannishy GAH, Sayed-Ahmed NAH, Abd El Wahab AM. Is health-related quality of life associated with adequacy of hemodialysis in chronic kidney disease patients? *BMC Nephrol.* 2021;21:334.
- Siswandi, Simanjuntak LB, Wulandari D, Dania H, Irham LM, Farida IN, et al. Nutritional Status and Quality of Life of Hemodialysis Patients in a Hospital in Yogyakarta. *Pharmacon* 2023;20:1411-283.
- Nunes FT, De Campos G, De Paula SMX, Merhi V a. L, Portero-mcLellan KC, Da Motta DG, et al. Dialysis adequacy and nutritional status of hemodialysis patients. *Hemodialysis International* 2008;12:45–51.
- Hong WP, Lee YJ. The association of dialysis adequacy, body mass index, and mortality among hemodialysis patients. *BMC Nephrology* 2019;20:382.
- National Kidney Foundation. KDOQI clinical practice guideline for hemodialysis adequacy: 2015 update. *Am J Kidney Dis* 2015;66:884–930.
- Chayati N, Ibrahim K, Komariah M. The effect of dialyzer surface area on dialysis adequacy achievement in hemodialysis patients at PKU Muhammadiyah Hospital Yogyakarta. *Muhammadiyah J Nurs.* 2014;1:66-77.
- Prabhaswari L, Werdi IGSP, Sunaka IW. Association between nutritional status and quality of life in chronic kidney disease patients undergoing hemodialysis at Wangaya General Hospital, Denpasar, Bali. *Intisari Sains Medis.* 2020;11:1451–5.
- Supriyadi R, Rakhima F, Gondodiputro RS, Darmawan G. Validity and reliability of the Indonesian version of kidney disease quality of life (kdqol-36) questionnaire in hemodialysis patients at hasan sadikin hospital, Bandung, Indonesia. *Acta Med Indones.* 2019;51:318-23.
- Novinka C, Gea D, Fadsya F, Sari N, Br. Tarigan RM, Nababan T. Relationship Between Hemodialysis Adequacy and Quality Of Life of Chronic Renal Failure Patients in RSU. Royal Prima Medan in 2022. *J Keperawatan dan Fisioter JFKF.* 2022;5:1–8.
- Kalantar-Zadeh K, Ikizler TA, Block G, Avram MM, Kopple JD. Malnutrition-inflammation complex syndrome in dialysis patients: causes and consequences. *Am J Kid Dis.* 2003;42:864–81.
- Yen TH, Lin JL, Lin-Tan DT, Hsu CW. Association between body mass index and mortality in hemodialysis patients: Interaction with dialysis adequacy and inflammation. *Therapeutic Apheresis and Dialysis.* 2010;14:400–8.
- Pupim LB, Himmelfarb J, McMonagle E, Shyr Y, Ikizler TA. Influence of initiation of maintenance hemodialysis on biomarkers of inflammation and nutritional status. *Kid Int.* 2004;65:238–47.

19. Ikizler TA, Cano NJ, Franch H. Prevention and treatment of protein energy wasting in chronic kidney disease patients: a consensus statement by the International Society of Renal Nutrition and Metabolism. *Kidney Int.* 2013;84:1096–107.
20. Riehl-Tonn VJ, MacRae JM, Dumanski SM, Elliot MJ, Paanu N, Schick-Makaroff K, et al. Sex and gender differences in health-related quality of life in individuals treated with incremental and conventional hemodialysis. *Clin Kidney J.* 2023;17:123–31.
21. Pratiwi DT, Tamtomo DG, Suryono A. Determinants of the Quality of Life for Hemodialysis Patients. *Indonesian J Med.* 2019;4:145–54.
22. Soleymanian T, Nejati M, Kabiri Esfahani M, Argani H. SF36 quality of life and mortality across different levels of serum albumin in patients with hemodialysis. *Nephro Urol Monthly.* 2017;9:45319.
23. Masià-Plana A, Sitjar-Suñer M, Mantas-Jiménez S, Suñer-Soler R. The influence of emotional intelligence on quality of life in patients undergoing chronic hemodialysis focused on age and gender. *Behav Sci.* 2024;14:220.
24. Nadort E, Rijkers N, Schouten RW, Hoogveen EK, Bos WJW, Vleming LJ, et al. Depression, anxiety and quality of life of hemodialysis patients before and during the COVID-19 pandemic. *J Psychosomatic Res.* 2022;158:110917.
25. Mukai H, Villafuerte H, Qureshi AR, Lindholm B, Stenvinkel P. Serum albumin, inflammation, and nutrition in end-stage renal disease: C-reactive protein is needed for optimal assessment. *Seminars in Dialysis.* 2018;31:435–9.
26. Bross R, Zitterkoph J, Pithia J, Benner D, Rambod M, Kovesdy CP, et al. Association of serum total iron-binding capacity and its changes over time with nutritional and clinical outcomes in hemodialysis patients. *American J Nephrol.* 2009;29:571–81.

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