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The Relationship Between Physiological Adaptation and Fluid Restriction in Patients with Chronic Kidney Disease Based on the Roy Adaptation Model

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Abstract

Background: Fluid restriction is essential for patients with chronic kidney disease (CKD) undergoing hemodialysis. However, adherence remains challenging and may be associated with patients' physiological adaptation.

Purpose: This study aimed to determine the relationship between physiological adaptation and fluid restriction adherence among patients with CKD based on the Roy Adaptation Model.

Methods: A cross-sectional correlational study was conducted among 129 patients with CKD at RSU Islam Klaten, Indonesia, selected through purposive sampling. Data were analyzed using the chi-square test and Fisher's exact test with Monte Carlo estimation.

Results: Most participants demonstrated moderate physiological adaptation (65.1%) and moderate fluid restriction adherence (65.9%). Poor physiological adaptation was identified in 25.6% of participants, while 23.3% were non-adherent. Non-adherence was more frequent among participants with poor adaptation (39.4%) than among those with moderate (17.9%) or good adaptation (16.7%). Fisher's exact test with Monte Carlo estimation showed a statistically significant association between physiological adaptation and fluid restriction adherence (*p* = 0.046). However, the association was weak (Cramér's V = 0.196).

Conclusions: Physiological adaptation was significantly associated with fluid restriction adherence, although the association was weak. Nursing care should consider patients' adaptation when providing individualized education and self-care support. Further research is needed to identify additional factors influencing adherence.

Keywords: chronic kidney disease; fluid restriction; hemodialysis; physiological adaptation; Roy Adaptation Model

Introduction

Chronic kidney disease (CKD) is a major health problem that requires long-term management to prevent disease progression and reduce complications. For patients with advanced CKD, particularly those receiving hemodialysis, maintaining fluid balance is an important component of treatment. Reduced kidney function limits the body's ability to regulate fluid and electrolyte balance, making patients vulnerable to fluid accumulation between dialysis sessions. Excessive fluid intake may contribute to hypervolemia, edema, increased blood pressure, and other complications that can complicate clinical management. Therefore,

adherence to prescribed fluid restrictions is an essential part of self-management among patients undergoing hemodialysis (Stevens et al., 2024; Herwinda et al., 2023).

Despite its importance, adherence to fluid restriction remains a challenge for many patients receiving hemodialysis. Fluid restriction requires patients to regulate their daily intake consistently while managing thirst, dietary habits, symptoms, and changes in their daily routines. Previous research has identified several factors associated with adherence, including knowledge, family support, and other individual and contextual factors (Chironda & Bhengu, 2016; Ningrum et al., 2020; Trisnaningtyas et al., 2023). A systematic review and meta-analysis by Vijay and Kang (2022) also examined the prevalence of non-adherence to dietary and fluid restrictions among patients undergoing hemodialysis, highlighting the importance of addressing adherence as part of routine kidney care. Poor fluid management may affect patients' clinical condition and quality of life, emphasizing the need for nursing approaches that support sustainable self-care practices (Bandola et al., 2023).

Fluid restriction adherence may also be considered in relation to patients' physiological adaptation to the demands of chronic illness and hemodialysis. The Roy Adaptation Model conceptualizes individuals as adaptive systems who respond to environmental stimuli through physiological and psychosocial processes. Its physiological mode focuses on the body's responses and the maintenance of physiological integrity, making it relevant to nursing assessment and care for patients with CKD (Alligood, 2019; Callis, 2020). In the context of hemodialysis, physiological adaptation may be reflected in how patients respond to changes in fluid balance and manage the physical demands associated with their illness and treatment. Examining physiological adaptation alongside fluid restriction adherence may therefore help nurses understand patients' self-management beyond the provision of information alone.

Previous studies have explored the application of the Roy Adaptation Model in patients receiving hemodialysis. Afrasiabifar et al. (2013) examined Roy's Adaptation Model-based patient education to promote adaptation among hemodialysis patients. More recent studies have investigated education guided by the Roy Adaptation Model in relation to fluid adherence and disease acceptance (Çayır Yılmaz & Yılmaz Karabulutlu, 2023), as well as fluid management, symptom control, and quality of life (Ozdemir & Unsar, 2024). These studies support the relevance of adaptation-oriented nursing care in hemodialysis. However, the relationship between physiological adaptation and fluid restriction adherence remains important to examine in specific clinical settings, particularly to clarify whether differences in adaptation status are associated with differences in patients' adherence to prescribed fluid restrictions.

Although previous studies have demonstrated the potential application of the Roy Adaptation Model in supporting adaptation and self-management among patients undergoing hemodialysis, further investigation is needed to understand the relationship between patients' physiological adaptation status and their adherence to prescribed fluid restrictions. Previous studies have primarily focused on the implementation of adaptation-based educational interventions and their effects on clinical or psychosocial outcomes. However, the association between physiological adaptation and fluid restriction adherence in routine hemodialysis care remains insufficiently explored, particularly in Indonesian clinical settings. This gap highlights the importance of examining physiological adaptation as a potential factor associated with fluid restriction adherence, thereby providing a more comprehensive understanding of patients' self-management behaviors.

At RSU Islam Klaten, Indonesia, preliminary observations conducted on January 8, 2026, indicated that fluid restriction was an important issue in the care of patients undergoing hemodialysis. Information obtained during the preliminary assessment described patients who had difficulty adhering to fluid restrictions, including instances of interdialytic weight gain exceeding recommended limits and the occurrence of edema. These observations suggest a need to examine patient-related factors that may be associated with fluid management practices. However, the preliminary information does not establish the extent of non-adherence or whether it is associated with patients' physiological adaptation; these questions require systematic investigation.

Understanding the relationship between physiological adaptation and fluid restriction adherence may provide evidence to support nursing assessment and individualized patient education for people living with CKD who undergo hemodialysis. Accordingly, this study aimed to determine the relationship between physiological adaptation and adherence to fluid restriction among patients with CKD at RSU Islam Klaten, Indonesia, using the Roy Adaptation Model as the conceptual framework.

Materials and Methods

Design

This study employed a quantitative observational study with a cross-sectional correlational design to examine the association between physiological adaptation and adherence to fluid restriction among patients with chronic kidney disease (CKD), based on the Roy Adaptation Model. The cross-sectional approach enabled both variables to be assessed within the same study period to determine whether physiological

adaptation categories were associated with fluid restriction adherence. No experimental intervention or manipulation of treatment was performed.

Participants and Setting

The study was conducted at RSU Islam Klaten, Indonesia, a hospital providing healthcare services, including hemodialysis, for patients with CKD. The target population comprised patients diagnosed with CKD who were receiving care at the hospital and had followed a prescribed fluid restriction regimen for at least one month.

Participants were selected using purposive sampling based on predefined inclusion and exclusion criteria. The inclusion criteria were: (1) a diagnosis of CKD at stages 3–5; (2) age 18 years or older; (3) the ability to provide informed consent; (4) the ability to complete the study questionnaire and respond to questions concerning physiological adaptation and fluid restriction adherence; and (5) adherence to a prescribed fluid restriction regimen for at least one month. Patients were excluded if they had severe cognitive or psychological impairments that prevented them from completing the assessment, acute conditions requiring emergency management, or declined participation or withdrew from the study.

A total of 129 participants with complete data were included in the final analysis. The primary variables were physiological adaptation and adherence to fluid restriction. Participant characteristics, including age, sex, duration of CKD, and comorbid conditions, were also considered in describing the study population.

Ethical consideration

The study received ethical approval from the Health Research Ethics Committee, Faculty of Medicine, Universitas Muhammadiyah Surakarta, Indonesia (Ethical Clearance No. 6397/B.1/KEPK-FKUMS/VI/2026), dated June 9, 2026. The ethical clearance letter states that the research proposal was reviewed and declared ethically approved in accordance with the Declaration of Helsinki, the Council for International Organizations of Medical Sciences (CIOMS), and World Health Organization (WHO) guidelines.

Written informed consent was obtained from participants before their involvement in the study. Participation was voluntary, and participants were informed of their right to decline participation or withdraw at any time without affecting their healthcare services. Confidentiality was maintained by assigning identification codes to participants and securely storing research records. Access to identifiable information was restricted to authorized research personnel, and the data were intended solely for academic and scientific purposes.

Data collection

Data collection involved clinical observations, medical record reviews, and the administration of a questionnaire on fluid restriction adherence. Eligible participants were identified according to the predefined criteria and informed about the study objectives and procedures before providing written informed consent.

Physiological adaptation was assessed using clinical indicators and information obtained from medical records. The recorded indicators included blood pressure, pulse rate, body weight, fluid status, edema, and relevant laboratory parameters, including serum creatinine, blood urea nitrogen (BUN), and estimated glomerular filtration rate (eGFR). These indicators were used to describe the participants' physiological conditions in the context of CKD and fluid management.

Fluid restriction adherence was assessed using a questionnaire developed with reference to fluid restriction recommendations for patients with CKD. The questionnaire addressed daily fluid intake, the frequency of adherence to prescribed restrictions, and participants' perceptions of fluid restriction. Supplementary information regarding fluid management practices and adaptation strategies was obtained through brief interviews where applicable.

Demographic and clinical information, including age, sex, duration of CKD, and comorbidities such as hypertension and diabetes, was also recorded. Data collection procedures were arranged according to participants' clinical conditions and hemodialysis schedules to minimize disruption to routine care.

The research proposal specified content validity assessment by nursing experts and reliability testing of the adherence questionnaire using Cronbach's alpha. However, the final validity and reliability coefficients were not available in the materials provided and therefore are not reported here.

Data analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to summarize physiological adaptation and fluid restriction adherence categories. Frequencies and percentages were calculated to describe the distribution of participants across the categories.

The association between physiological adaptation and fluid restriction adherence was examined using a chi-square test of independence. The contingency table consisted of three physiological adaptation categories (good, moderate, and poor) and three fluid restriction adherence categories (adherent, moderately adherent, and non-adherent). Because 33.3% of the cells had expected counts below five, Fisher's exact test with Monte Carlo estimation was used to assess statistical significance. The strength of the association was evaluated using Cramér's V.

A two-sided p-value of less than 0.05 was considered statistically significant. The final analysis included 129 valid cases, with no missing data. The results were interpreted in terms of the statistical association between physiological adaptation and fluid restriction adherence, without inferring a causal relationship.

Results

A total of 129 patients with chronic kidney disease (CKD) were included in the analysis. No missing data were identified for the variables examined. The participants' demographic characteristics, clinical conditions, physiological adaptation categories, and fluid restriction adherence are presented in Table 1.

Table 1. Characteristics of the participants and univariate findings (n = 129)

Variable	Category	n	%
Sex	Male	72	55.8
	Female	57	44.2
Age group	Young adults (20–44 years)	19	14.7
	Middle-aged adults (45–59 years)	64	49.6
	Older adults (60–74 years)	43	33.3
	Older adults (75–90 years)	3	2.3
Kidney function category	Poor	107	82.9
	Moderate	22	17.1
Vital signs category	Unstable	58	45.0
	Relatively stable	45	34.9
	Stable/within normal limits	26	20.2
Pitting edema	Present	43	33.3
	Absent	86	66.7
Physical examination category	Poor	102	79.1
	Moderate	27	20.9
Physiological adaptation	Good	12	9.3
	Moderate	84	65.1
	Poor	33	25.6
Fluid restriction adherence	Adherent	14	10.9
	Moderately adherent	85	65.9
	Non-adherent	30	23.3

Regarding sex, 72 participants (55.8%) were male and 57 (44.2%) were female. In terms of age, the largest group consisted of middle-aged adults aged 45–59 years, accounting for 64 participants (49.6%), followed by older adults aged 60–74 years (43; 33.3%), young adults aged 20–44 years (19; 14.7%), and older adults aged 75–90 years (3; 2.3%).

Regarding kidney function, 107 participants (82.9%) were classified as having poor kidney function, characterized by substantially increased serum creatinine and blood urea nitrogen (BUN) levels and severely decreased or fluctuating estimated glomerular filtration rate (eGFR). The remaining 22 participants (17.1%)

were classified as having moderately impaired kidney function, characterized by slightly increased creatinine and BUN levels and a mild decrease in eGFR.

For vital signs, 58 participants (45.0%) were classified as having unstable blood pressure and/or frequent pulse abnormalities, while 45 (34.9%) had occasional increases in blood pressure or pulse rate and were categorized as relatively stable. The remaining 26 participants (20.2%) had blood pressure and pulse rates within normal limits or under stable control.

Physical examination findings showed that 43 participants (33.3%) had pitting edema, whereas 86 (66.7%) did not. Based on the overall physical examination classification, 102 participants (79.1%) were categorized as having poor clinical status, characterized by moderate-to-severe edema and post-dialysis weight gain exceeding 1 kg. The remaining 27 participants (20.9%) were classified as having relatively better clinical status, characterized by mild edema and weight gain of 1 kg or less.

Regarding physiological adaptation, 84 participants (65.1%) were classified as having moderate adaptation, 33 (25.6%) had poor adaptation, and 12 (9.3%) demonstrated good adaptation.

In terms of fluid restriction adherence, 85 participants (65.9%) were moderately adherent, 30 (23.3%) were non-adherent, and 14 (10.9%) were adherent. Thus, moderate adherence was the most common category, while full adherence was observed in only a small proportion of the participants.

Overall, the univariate findings indicate that most participants were middle-aged adults, had poor kidney function according to the study classification, demonstrated moderate physiological adaptation, and exhibited moderate adherence to fluid restriction. A substantial proportion also had poor clinical status according to the physical examination classification used in the study.

Table 2. Association between Physiological Adaptation and Fluid Restriction Adherence among Patients with CKD (n = 129)

Physiological adaptation	Adherent, n (%)	Moderately adherent, n (%)	Non-adherent, n (%)	Total, n (%)
Good	0 (0.0)	10 (83.3)	2 (16.7)	12 (100.0)
Moderate	9 (10.7)	60 (71.4)	15 (17.9)	84 (100.0)
Poor	5 (15.2)	15 (45.5)	13 (39.4)	33 (100.0)
Total	**14 (10.9)**	**85 (65.9)**	**30 (23.3)**	**129 (100.0)**

The association between physiological adaptation and fluid restriction adherence among patients with chronic kidney disease (CKD) was analyzed using a contingency table and Fisher's exact test with Monte

Carlo estimation. A total of 129 participants were included in the analysis, with no missing data. The results are presented in Table 2.

Among the 12 participants with good physiological adaptation, 10 (83.3%) were moderately adherent to fluid restriction, while 2 (16.7%) were non-adherent. None were classified as fully adherent. Among the 84 participants with moderate physiological adaptation, 60 (71.4%) were moderately adherent, 15 (17.9%) were non-adherent, and 9 (10.7%) were fully adherent. Of the 33 participants with poor physiological adaptation, 15 (45.5%) were moderately adherent, 13 (39.4%) were non-adherent, and 5 (15.2%) were fully adherent.

Table 3. Bivariate test results

Statistical measure	Result
Pearson Chi-square	9.875
Degrees of freedom (df)	4
Pearson Chi-square asymptotic p-value	0.043
Fisher's exact test (Monte Carlo, two-sided)	0.046
99% confidence interval for Monte Carlo p-value	0.040–0.051
Cramér's V	0.196
Number of valid cases	129

Fisher's exact test with Monte Carlo estimation demonstrated a statistically significant association between physiological adaptation and fluid restriction adherence ($p = 0.046$). This finding indicates that the distribution of fluid restriction adherence categories differed significantly across physiological adaptation categories. The association strength, assessed using Cramér's V, was 0.196, indicating a weak association. These findings suggest that physiological adaptation was associated with fluid restriction adherence; however, the cross-sectional design does not establish a causal relationship.

Discussion

Association Between Physiological Adaptation and Fluid Restriction Adherence

The present study examined the association between physiological adaptation and adherence to fluid restriction among 129 patients with chronic kidney disease (CKD). The findings demonstrated a statistically significant association between the two variables based on Fisher's exact test with Monte Carlo estimation (\(p = 0.042\); 99% CI: 0.037–0.047). The cross-tabulation showed that patients classified as having good physiological adaptation were predominantly moderately adherent to fluid restriction (10/12; 83.3%), while

two patients (16.7%) were non-adherent. Among patients with moderate physiological adaptation, 60 of 84 (71.4%) were moderately adherent, whereas 15 (17.9%) were non-adherent. In contrast, among patients with poor physiological adaptation, 13 of 33 (39.4%) were non-adherent, and 15 (45.5%) were moderately adherent. These findings suggest that poorer physiological adaptation may coexist with a greater proportion of fluid restriction non-adherence.

The association was statistically significant, although its magnitude was relatively small (Cramér's V = 0.196). This distinction is important because statistical significance does not necessarily indicate a strong clinical relationship. Furthermore, the study used a cross-sectional design; therefore, the findings demonstrate an association rather than a causal relationship. Physiological adaptation may be related to fluid restriction adherence, but the possibility that other clinical, psychological, and social factors influence both variables must also be considered.

The pattern of findings provides further insight into the potential relationship between physiological adaptation and fluid restriction adherence. Notably, the proportion of non-adherent patients was higher among those with poor physiological adaptation (39.4%) compared with those with moderate (17.9%) and good physiological adaptation (16.7%). This pattern suggests that patients experiencing greater difficulties in physiological adaptation may also encounter challenges in maintaining recommended fluid intake. One possible explanation is that physiological disturbances associated with CKD, including fluid accumulation, edema, and blood pressure changes, may increase the complexity of daily self-management. Patients experiencing these conditions may require additional support to recognize physiological changes and implement appropriate fluid-management behaviors.

Nevertheless, the relatively small association observed in this study (Cramér's V = 0.196) indicates that physiological adaptation represents only one aspect of fluid restriction adherence. This finding is consistent with the multifactorial nature of self-management in patients receiving hemodialysis. Individual motivation, health literacy, family involvement, treatment-related experiences, and environmental circumstances may also influence adherence behaviors. Therefore, the findings support a comprehensive nursing assessment that considers physiological adaptation together with individual and contextual determinants rather than relying on physiological status as the sole indicator of adherence.

The findings are relevant to the clinical management of CKD because fluid restriction is an essential component of self-management, particularly among patients receiving hemodialysis. Impaired kidney function can reduce the body's capacity to maintain fluid and electrolyte balance, making adherence to

prescribed fluid intake an important component of treatment. Nevertheless, adherence is a complex behavior that cannot be explained by physiological status alone.

A systematic review by Yasin et al. (2024) identified multiple barriers and facilitators affecting self-care and disease management among patients receiving dialysis. Their findings emphasized the individual nature of self-management and the importance of patient empowerment and individualized care strategies. This supports the interpretation that physiological adaptation should be considered alongside patients' daily experiences, treatment demands, and available support when evaluating fluid restriction adherence.

Physiological Adaptation and the Roy Adaptation Model

The findings can be interpreted through the Roy Adaptation Model, which conceptualizes individuals as adaptive systems that respond to internal and external stimuli. In this framework, physiological adaptation is one of four adaptive modes and concerns the body's physical and physiological responses to environmental and health-related changes. For patients with CKD, these responses may include fluid balance, edema, blood pressure regulation, nutritional status, and the management of symptoms associated with impaired kidney function.

The observed association suggests that physiological adaptation is a relevant dimension to consider when assessing fluid restriction adherence. Patients experiencing greater physiological difficulties may require more intensive assistance to manage fluid intake, recognize early symptoms of fluid overload, and incorporate treatment recommendations into daily routines. However, physiological adaptation and adherence should not be regarded as interchangeable concepts. A patient may experience relatively stable physiological conditions without consistently adhering to fluid restrictions, while another patient may adhere to recommendations yet continue to experience physiological complications because of advanced disease.

Direct evidence supporting the clinical application of Roy's model is provided by Ozdemir and Unsar (2024), who conducted a randomized controlled study involving 107 patients receiving hemodialysis. Their intervention used educational materials developed according to the Roy Adaptation Model. The study reported improvements in fluid management, symptom control, and quality of life among patients receiving the intervention. These findings support the potential usefulness of theory-based nursing education in helping patients adapt to the demands of hemodialysis and fluid management.

From a scientific perspective, this study contributes to the development of nursing knowledge by providing empirical evidence regarding the association between physiological adaptation and fluid

restriction adherence among patients with CKD undergoing hemodialysis. The findings extend the application of the Roy Adaptation Model beyond its use as a framework for educational interventions by demonstrating its potential relevance in understanding patient self-management characteristics. Specifically, the results highlight the importance of considering physiological adaptation when examining adherence-related behaviors in patients living with chronic illness.

Furthermore, this study provides a basis for integrating adaptation theory into research on chronic disease self-management. By examining physiological adaptation in relation to fluid restriction adherence, the study offers an additional perspective on how patients' physiological responses may be associated with their ability to manage treatment recommendations. However, the relatively small association indicates that future theoretical and empirical investigations should also consider other adaptive modes and contextual factors. This may contribute to a more comprehensive understanding of adaptation processes and self-management behaviors among patients receiving long-term treatment.

The present study complements this evidence by identifying an association between physiological adaptation categories and fluid restriction adherence in a sample of 129 patients. Whereas the randomized controlled study evaluated the effects of an educational intervention, the present study examined the relationship between two patient characteristics. Consequently, the findings provide complementary rather than equivalent evidence: the current results support the clinical relevance of assessing adaptation, while the intervention study provides evidence that education informed by Roy's model may improve fluid management outcomes.

From a nursing perspective, the model can be used to organize individualized assessments and interventions. Nurses can identify physiological problems, assess patients' responses to fluid restrictions, explore barriers to self-management, and develop educational strategies that reflect each patient's needs and adaptive capacity. This approach emphasizes not only the control of symptoms but also the development of sustainable self-management behaviors.

Fluid Restriction Adherence as a Component of CKD Self-Management

In the present study, 85 patients (65.9%) were classified as moderately adherent to fluid restriction, 30 (23.3%) were non-adherent, and only 14 (10.9%) were adherent. This distribution indicates that optimal adherence was uncommon in the study population, despite moderate adherence being the most frequent category. These findings suggest that fluid restriction remains a practical challenge for many patients with CKD and that there is room for improvement in routine nursing care.

Fluid restriction requires patients to make repeated decisions about drinking throughout the day. Thirst, dry mouth, dietary sodium intake, habitual drinking patterns, social activities, and the availability of family support may influence these decisions. Patients may understand the importance of fluid restriction but still find it difficult to follow consistently. Therefore, knowledge alone may be insufficient to achieve sustained adherence.

Evidence from a systematic review and meta-analysis by Vijay and Kang (2022) further demonstrates the importance of this problem. Their review of 23 studies involving 11,209 patients receiving hemodialysis estimated the pooled prevalence of non-adherence to fluid restrictions at 60.6% (95% confidence interval [CI]: 50.0%–70.7%). The authors also noted substantial variation between studies, indicating that non-adherence estimates should be interpreted in the context of differences in populations and measurement methods.

Although the percentage of non-adherent patients in the present study was lower than the pooled estimate reported by Vijay and Kang, direct comparisons should be made cautiously. The current study classified adherence into three categories, whereas the meta-analysis synthesized non-adherence estimates across studies using varying definitions and assessment methods. In addition, the present study's largest group consisted of moderately adherent patients, suggesting that many participants may have followed fluid restriction recommendations inconsistently rather than completely disregarding them.

This distinction has practical implications. Nursing interventions should not focus exclusively on patients classified as non-adherent. Patients with moderate adherence may also benefit from individualized guidance to strengthen existing behaviors, identify situations that lead to excessive fluid intake, and establish realistic daily fluid-management strategies. Such support may help patients progress toward more consistent adherence while accounting for their symptoms, treatment schedules, and individual circumstances.

Implications for Nursing Practice and Patient Education

The findings highlight the importance of integrating physiological assessment with individualized education when supporting fluid restriction adherence among patients with CKD. Routine nursing care should extend beyond providing general information about recommended fluid intake. Instead, nurses should assess patients' physiological responses, understanding of fluid management, perceived barriers, daily habits, and capacity to implement self-care recommendations.

One potential strategy is to combine Roy-based assessment with practical fluid-management education. For example, nurses can help patients identify their prescribed daily fluid allowance, distribute fluid intake throughout the day, monitor body weight according to clinical recommendations, and recognize

symptoms that may indicate fluid overload. Education should be individualized to the patient's clinical condition and prescribed treatment rather than applying identical fluid limits to every patient.

Digital education may also support ongoing self-management. Torabikhah et al. (2023) compared mobile health education using the Di Care application with face-to-face education in a randomized clinical trial involving 70 patients receiving hemodialysis. Both approaches improved indicators of fluid and dietary adherence, while the mobile health group showed a greater reduction in interdialytic weight gain than the face-to-face group (\(p = 0.001\)). These results suggest that digital resources may complement conventional nursing education, particularly when patients need repeated access to practical guidance between dialysis sessions. Nevertheless, digital interventions should be adapted to patients' digital literacy, access to devices, and preferences. Face-to-face education, family involvement, and regular follow-up remain important, especially for patients who have difficulty using digital technology or managing complex treatment regimens. The most appropriate strategy is therefore a patient-centred approach that combines clinical monitoring, tailored education, and continuing support.

Within the Roy Adaptation Model, these interventions can be directed toward improving patients' responses to physiological changes and strengthening their ability to manage treatment demands. The model provides a useful framework for organizing nursing care, although the present cross-sectional findings do not establish that Roy-based interventions would necessarily improve adherence in this particular population. Such an effect would need to be evaluated in an intervention study.

The practical implications of these findings extend to nursing assessment, clinical decision-making, and the development of individualized patient education programs. In hemodialysis settings, nurses may consider incorporating physiological adaptation assessment into routine evaluations of patients' fluid-management behaviors. Particular attention should be given to patients demonstrating poor physiological adaptation, as this group presented a higher proportion of fluid restriction non-adherence in the present study. Early identification of difficulties may help nurses determine which patients require more intensive education, monitoring, and supportive interventions.

In addition, nursing education should emphasize practical strategies that patients can implement in their daily lives, including understanding prescribed fluid allowances, monitoring interdialytic weight gain, managing thirst, recognizing signs of fluid overload, and involving family members in self-care activities when appropriate. Educational interventions should be delivered continuously and evaluated according to patients' individual needs and responses. The integration of physiological assessment, behavioral support,

and patient-centred education may provide a more comprehensive approach to improving fluid restriction adherence among patients undergoing hemodialysis.

At the institutional level, the findings may inform the development of standardized nursing education protocols and assessment procedures for fluid management in hemodialysis units. Such protocols could incorporate physiological adaptation indicators and individualized follow-up strategies. However, their effectiveness should be evaluated through further intervention research before being recommended as established clinical protocols.

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design limits the ability to establish temporal relationships or causal associations between physiological adaptation and fluid restriction adherence. Second, the study was conducted at a single healthcare institution, RSU Islam Klaten, Indonesia, with a sample of 129 patients. Therefore, the findings may not be directly generalizable to patients receiving hemodialysis in other healthcare settings with different patient characteristics and clinical practices. Third, the relatively small magnitude of the observed association suggests that other determinants of fluid restriction adherence may not have been fully captured in the present analysis.

Future studies should consider longitudinal designs to examine changes in physiological adaptation and fluid restriction adherence over time. Multicentre studies involving larger and more diverse populations are also recommended to improve the generalizability of the findings. Furthermore, intervention studies based on the Roy Adaptation Model could investigate whether individualized nursing education and adaptation-focused interventions can improve fluid restriction adherence and related clinical outcomes, including interdialytic weight gain, blood pressure control, and symptoms of fluid overload.

Conclusions

This study identified a statistically significant association between physiological adaptation and fluid restriction adherence among patients with chronic kidney disease (CKD) undergoing hemodialysis ($p = 0.046$, Fisher's exact test with Monte Carlo estimation). Most participants demonstrated moderate physiological adaptation (65.1%) and moderate adherence to fluid restriction (65.9%). However, 25.6% of participants had poor physiological adaptation, and 23.3% were classified as non-adherent to fluid restriction. Non-adherence was more frequent among participants with poor physiological adaptation (39.4%) than among those with moderate (17.9%) or good physiological adaptation (16.7%). Nevertheless, the strength of the association was small (Cramér's $V = 0.196$), indicating that physiological adaptation alone may not fully explain fluid

restriction adherence. These findings support the importance of nursing interventions that integrate physiological assessment, individualized fluid management education, and ongoing evaluation of patients' self-care practices. Further longitudinal and interventional studies are needed to clarify the direction of this relationship and investigate other factors influencing fluid restriction adherence in patients with CKD.

Declaration of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this study.

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Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable ethical requirements and participant confidentiality protections.

References

Afrasiabifar, A., Karimi, Z., & Hassani, P. (2013). Roy's Adaptation Model-Based Patient Education for Promoting the Adaptation of Hemodialysis Patients. *Iranian Red Crescent Medical Journal*, *15*(7), 566–572. https://doi.org/10.5812/ircmj.12024

Alligood, M. R. (2019). *Nursing theorists and their work 8 edition*. Elsvier Mosby.

Angesti, V. Y., & Purwanti, O. S. (2025). The Relationship Between Hemodialysis Length, Frequency, and Anxiety in Chronic Kidney Disease Patients. *Jurnal Ilmiah Ilmu Keperawatan Indonesia*, *15*(02), 95–107. https://doi.org/10.33221/jiiki.v15i02.4006

Anisah, I. N., & Maliya, A. (2021). Efektivitas Relaksasi Benson Terhadap Kecemasan Pasien Yang Menjalani

Hemodialisa. *Jurnal Berita Ilmu Keperawatan*, *14*(1), 57–64. https://doi.org/10.23917/bik.v14i1.12226

Arhuidese, I. J., Cooper, M. A., Rizwan, M., Nejim, B., & Malas, M. B. (2019). Vascular access for hemodialysis in the elderly. *Journal of Vascular Surgery*, *69*(2), 517-525.e1. https://doi.org/10.1016/j.jvs.2018.05.219

Bandola, Y. I., Artini, B., & Nancye, P. M. (2023). HUBUNGAN KEPATUHAN PEMBATASAN CAIRAN DENGAN KUALITAS HIDUP PASIEN GAGAL GINJAL KRONIK YANG MENJALANI HEMODIALISIS. *Jurnal Keperawatan*, *12*(1), 9–16. https://doi.org/10.47560/kep.v12i1.475

Barbieri, M., Chiodini, P., Di Gennaro, P., Hafez, G., Liabeuf, S., Malyszko, J., Mani, L.-Y., Mattace-Raso, F., Pepin, M., Perico, N., Simeoni, M., Zoccali, C., Tortorella, G., Capuano, A., Remuzzi, G., Capasso, G., & Paolisso, G. (2024). Efficacy of erythropoietin as a neuroprotective agent in CKD-associated cognitive dysfunction: A literature systematic review. *Pharmacological Research*, *203*, 107146. https://doi.org/10.1016/j.phrs.2024.107146

Bologna, A., Foligno, N. E., & Vezzoli, G. (2023). Evaluation of Protein Malnutrition in CKD Patients on Low-Protein Diet. *Journal of the American Society of Nephrology*, *34*(11S), 351–351. https://doi.org/10.1681/ASN.2023411S1351b

Browning, Callis, A. M. (2020). Application of the Roy Adaptation Theory to a care program for nurses. *Applied Nursing Research*, *56*. https://doi.org/https://doi.org/10.1016/j.apnr.2020.151340

Cashmore, B. A., Cooper, T. E., Evangelidis, N. M., Green, S. C., Lopez-Vargas, P., & Tunnicliffe, D. J. (2024). Education programmes for people with chronic kidney disease and diabetes. *Cochrane Database of Systematic Reviews*, *2024*(8). https://doi.org/10.1002/14651858.CD007374.pub3

ÇAYIR YILMAZ, M., & YILMAZ KARABULUTLU, E. (2023). The Effect of Roy Adaptation Model Guided Education on Fluid Adherence and Disease Acceptance of Hemodialysis Patients: A Nonrandomized Interventional Study. *Journal of Basic and Clinical Health Sciences*, *7*(1), 139–148. https://doi.org/10.30621/jbachs.1079366

Chironda, G., & Bhengu, B. (2016). Contributing Factors to Non-Adherence among Chronic Kidney Disease (CKD) Patients: A Systematic Review of Literature. *Medical & Clinical Reviews*, *02*(04). https://doi.org/10.21767/2471-299X.1000038

Conley, M. M., Mayr, H. L., Hepburn, K. S., Holland, J. J., Mudge, D. W., Tonges, T. J., Modderman, R. S., Gerzina, S. A., Johnson, D. W., Viecelli, A. K., & MacLaughlin, H. L. (2025). Low Energy Diets for Obesity and CKD (SLOW-CKD Randomized Feasibility Study). *Kidney International Reports*, *10*(7), 2153–2164. https://doi.org/10.1016/j.ekir.2025.04.021

Escudero-Lopez, M., Martinez-Andres, M., Marcilla-Toribio, I., Moratalla-Cebrian, M. L., Perez-Moreno, A.,

& Bartolome-Gutierrez, R. (2024). Barriers and facilitators in self-care and management of chronic kidney disease in dialysis patients: A systematic review of qualitative studies. Journal of Clinical Nursing, 33(10), 3815–3830. https://doi.org/10.1111/jocn.17193

F., A., F., S., F., D., & S., S. (2021). Breathing exercise and respiratory parameters in chronic kidney disease patients with hemodialysis. *International Journal of Epidemiology and Health Sciences*, *2*(10), 1. https://doi.org/10.51757/IJEHS.2.10.2021.245581

Ghimire, A., Wanner, C., & Tonelli, M. (2025). Closing CKD Treatment Gaps: Why Practice Guidelines and Better Drug Coverage Are Not Enough. *American Journal of Kidney Diseases*, *85*(4), 406–408. https://doi.org/10.1053/j.ajkd.2025.01.006

Hafeez, M. S., & Yuo, T. H. (2022). Kidney Disease Education Services: A Good Foundation, but More Is Needed! In *Kidney360* (Vol. 3, Issue 1, pp. 3–4). Lippincott Williams and Wilkins. https://doi.org/10.34067/KID.0007632021

Handika, B. V., Kristinawati, B., & Kristini, P. (2023). Baby Oil as Evidence-Based Nursing for Uremic Pruritus in Chronic Kidney Disease Patients. *Media Keperawatan Indonesia*, *6*(3), 191. https://doi.org/10.26714/mki.6.3.2023.191-197

Haumahu, J. J. M., Desi, & Anwar, M. A. (2023). PROSES ADAPTASI DAN MEKANISME KOPING PASIEN KANKER PARU MENURUT TEORI CALLISTA ROY. *Jurnal Ilmiah Keperawatan (Scientific Journal of Nursing)*, *9*(2), 378–386. https://doi.org/10.33023/jikep.v9i2.1541

Herwinda, H., Kusumajaya, H., & Faizal, K. M. (2023). Faktor-faktor yang berhubungan dengan kejadian hipervolemia pada pasien Gagal Ginjal Kronik yang menjalani hemodialisis di ruang hemodialisa Rumah Sakit Medika Stannia Sungailiat tahun 2022. *Journal of Nursing Practice and Education*, *3*(2), 118–126. https://doi.org/https://doi.org/10.34305/jnpe.v3i2.678

Institute for Health Metrics and Evaluation. (2024). *GLOBAL BURDEN OF DISEASES, INJURIES, AND RISK FACTORS STUDY (GBD) PROTOCOL*.

John T, D., Blake, P. G., & Ing, T. S. (2025). *Handbook of dialysis*. Lippincott Williams & Wilkins (a Wolters Kluwer business).

Kemenkes BKPK. (2023). Survei Kesehatan Indonesia 2023 (SKI). *BADAN KEBIJAKAN PEMBANGUNAN KESEHATAN*.

Kerr, J. A., Patton, G. C., Cini, K. I., Abate, Y. H., Abbas, N., Abd Al Magied, A. H. A., Abd ElHafeez, S., Abd-Elsalam, S., Abdollahi, A., Abdoun, M., Abdulah, D. M., Abdulkader, R. S., Abdullahi, A., Abeywickrama, H. M., Abie, A., Abiodun, O., Abohashem, S., Abtahi, D., Abualruz, H., … Azzopardi,

P. S. (2025). Global, regional, and national prevalence of child and adolescent overweight and obesity, 1990–2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021. *The Lancet*, *405*(10481), 785–812. https://doi.org/10.1016/S0140-6736(25)00397-6

Krismiadi, D., Dina, H., Apriyanti, |, Nazaruddin, |, Mery Eka, |, & Fujianti, Y. (2024). Adaptasi pada Pasien Gagal Ginjal Kronik yang Melakukan Terapi Hemodialisis Berdasarkan Teori Sister Calista Roy: Literatur Review ARTICLE INFORMATION ABSTRACT. In *Indonesian Health Science Journal.id* (Vol. 4, Issue 1). https://doi.org/https://doi.org/10.52298/ihsj.v4i1.57

Kumar, S., Jan, R., Rattani, S., & Yaqoob, A. (2022). Theory Guided Practices: An Approach to Better Nursing Care through Roy Adaptation Model. *International Journal of Current Research and Review*, *14*(14), 58–63. https://doi.org/10.31782/IJCRR.2022.141410

Lestari, Y. S., & Hudiyawati, D. (2022). EFFECT OF FOOT MASSAGE ON REDUCING FATIGUE IN PATIENTS UNDERGOING HEMODIALYSIS. *Journal of Vocational Health Studies*, *5*(3), 166. https://doi.org/10.20473/jvhs.V5.I3.2022.166-173

Lianti, D., & Rosyid, F. N. (2024). Family support and self-care management of patients with chronic kidney disease undergoing hemodialysis. *Malahayati International Journal of Nursing and Health Science*, *7*(8), 1025–1032. https://doi.org/10.33024/minh.v7i8.291

Lok, C. E., Huber, T. S., Lee, T., Shenoy, S., Yevzlin, A. S., Abreo, K., Allon, M., Asif, A., Astor, B. C., Glickman, M. H., Graham, J., Moist, L. M., Rajan, D. K., Roberts, C., Vachharajani, T. J., & Valentini, R. P. (2020). KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. *American Journal of Kidney Diseases*, *75*(4), S1–S164. https://doi.org/10.1053/j.ajkd.2019.12.001

Mark, P. B., Stafford, L. K., Grams, M. E., Aalruz, H., Abd ElHafeez, S., Abdelgalil, A. A., Abdulkader, R. S., Abeywickrama, H. M., Abiodun, O. O., Abramov, D., Abrar, M. M., Abreu, L. G., Abubakar, B., Aburuz, S., Addo, I. Y., Adegboye, O. A., Adegoke, N. A., Adeyeoluwa, T. E., Adnani, Q. E. S., … Coresh, J. (2025). 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. *The Lancet*, *406*(10518), 2461–2482. https://doi.org/10.1016/S0140-6736(25)01853-7

Mazzaferro, S., Tartaglione, L., Cohen-Solal, M., Hoang Tran, M., Pasquali, M., Rotondi, S., & Ureña Torres, P. (2025). Pathophysiology and therapies of CKD-associated secondary hyperparathyroidism. *Clinical Kidney Journal*, *18*(Supplement_1), i15–i26. https://doi.org/10.1093/ckj/sfae423

Muntasir Nishat, M., Faisal, F., Rahman Dip, R., Nasrullah, S. M., Ahsan, R., Shikder, F., Ar-Raihan Asif, M. A.-, & Hoque, M. A. (2021). A Comprehensive Analysis on Detecting Chronic Kidney Disease by

Employing Machine Learning Algorithms. *EAI Endorsed Transactions on Pervasive Health and Technology*, *7*(29), e1. https://doi.org/10.4108/eai.13-8-2021.170671

Nasution, M. Z., Sikumbang, E. S., & Gurning, F. P. (2025). Analisis Tren Penyakit Gagal Ginjal Kronik Peserta BPJS dan Dampaknya pada Pembiayaan Kesehatan Indonesi. *Jurnal Kolaboratif Sains*, *8*(7), 4308–4317. https://doi.org/10.56338/jks.v8i7.7798

Ningrum, W. A. C., Drajat, M. R., & Imardiani, I. (2020). DUKUNGAN KELUARGA DAN PENGETAHUAN DENGAN KEPATUHAN PEMBATASAN CAIRAN PASIEN GAGAL GINJAL KRONIK. *Masker Medika*, *8*(1), 146–156. https://doi.org/10.52523/maskermedika.v8i1.387

Nursajidah, A., Harun, S., & Asnindari, L. N. (2024). Hubungan dukungan keluarga dengan kepatuhan pembatasan cairan pada pasien chronic kidney disease yang menjalani hemodialisa di RS PKU Muhammadiyah Yogyakarta. *Prosiding Seminar Nasional Penelitian Dan Pengabdian Kepada Masyarakat LPPM Universitas' Aisyiyah Yogyakarta*, *2*(September), 201–205.

Ong, K. L., Stafford, L. K., McLaughlin, S. A., Boyko, E. J., Vollset, S. E., Smith, A. E., Dalton, B. E., Duprey, J., Cruz, J. A., Hagins, H., Lindstedt, P. A., Aali, A., Abate, Y. H., Abate, M. D., Abbasian, M., Abbasi-Kangevari, Z., Abbasi-Kangevari, M., Abd ElHafeez, S., Abd-Rabu, R., … Vos, T. (2023). Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. *The Lancet*, *402*(10397), 203–234. https://doi.org/10.1016/S0140-6736(23)01301-6

Ozdemir, O., & Unsar, S. (2024). The effect of education given to hemodialysis patients based on the Roy Adaptation Model on fluid management, symptom control, and quality of life. Nursing & Health Sciences, 26(2), e13118. https://doi.org/10.1111/nhs.13118

Pambudiarto, A. A., Azizah, A. N., Amalia, L., Niswatin, T. K., Hudiyawati, D., & Susanti, E. (2024). Evidence Based Nursing: Penerapan Intervensi Progressive Muscle Relaxation untuk Meningkatkan Kualitas Tidur pada Pasien Hemodialisa di RSUD Ir. Soekarno Sukoharjo. *Jurnal Kreativitas Pengabdian Kepada Masyarakat (PKM)*, *7*(5), 2276–2287. https://doi.org/10.33024/jkpm.v7i5.14588

Qoyyimah, D. (2025). HUBUNGAN DUKUNGAN KELUARGA TERHADAP TINGKAT KEPATUHAN PEMBATASAN CAIRAN PADA PASIEN CKD YANG MENJALANI HEMODIALISIS. *Media Husada Journal Of Nursing Science*, *6*(1), 48–54. https://doi.org/10.33475/mhjns.v6i1.760

Rizzolo, K., Gardner, C., Camacho, C., Gonzalez Jauregui, R., Waikar, S. S., Chonchol, M., & Cervantes, L. (2024). In-Center Hemodialysis Experiences Among Latinx Adults: A Qualitative Study. *Kidney Medicine*, *6*(11). https://doi.org/10.1016/j.xkme.2024.100902

Rohmaniah, F. A., & Sunarno, R. D. (2022). EFIKASI DIRI UNTUK MENINGKATKAN KUALITAS HIDUP PASIEN GAGAL GINJAL KRONIK YANG MENJALANI HEMODIALISIS. *Jurnal Ilmu Keperawatan Dan Kebidanan*, *13*(1), 164–175. https://doi.org/10.26751/jikk.v13i1.1305

Roy, S. (2009). *The Roy adaptaion model.3nd ed*. Pearson Education & Upper Saddle River.

Ruchi, R., Bozorgmehri, S., Chamarthi, G., Orozco, T., Mohandas, R., Ozrazgat-Baslanti, T., Segal, M. S., & Shukla, A. M. (2022). Provision of Kidney Disease Education Service Is Associated with Improved Vascular Access Outcomes among US Incident Hemodialysis Patients. *Kidney360*, *3*(1), 91–98. https://doi.org/10.34067/KID.0004502021

Sari, A. T. P., Hudiyawati, D., Alzura, C., Nugraha, B. S., & Susanti, E. (2025). Efektivitas Pemberian Breathing Exercise Terhadap Penurunan Tingkat Fatigue Pada Pasien Hemodialisa. *Malahayati Nursing Journal*, *7*(10), 4588–4597. https://doi.org/10.33024/mnj.v7i10.22587

Septiwi, C., & Setiaji, W. R. (2020). PENERAPAN MODEL ADAPTASI ROY PADA ASUHAN KEPERAWATAN PASIEN DENGAN PENYAKIT GINJAL KRONIS. *Jurnal Ilmiah Kesehatan Keperawatan*, *16*(2), 101. https://doi.org/10.26753/jikk.v16i2.482

Shiu, Y.-T., Northrup, H., Huang, Y., Cho, M. E., & Bunsawat, K. (2025). Cellular and molecular mechanisms underlying hemodialysis arteriovenous fistula dysfunction and approaches to promote maturation: a vascular perspective. *American Journal of Physiology-Heart and Circulatory Physiology*, *329*(1), H241–H257. https://doi.org/10.1152/ajpheart.00010.2025

Shlipak, M. G., Tummalapalli, S. L., Boulware, L. E., Grams, M. E., Ix, J. H., Jha, V., Kengne, A.-P., Madero, M., Mihaylova, B., Tangri, N., Cheung, M., Jadoul, M., Winkelmayer, W. C., Zoungas, S., Abraham, G., Ademi, Z., Alicic, R. Z., de Boer, I., Deo, R., … Zomer, E. (2021). The case for early identification and intervention of chronic kidney disease: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference. *Kidney International*, *99*(1), 34–47. https://doi.org/10.1016/j.kint.2020.10.012

Singh, A. P., Heldaus, J., & Msaki, A. P. (2023). Hemodialysis Complications: A Clinical Insight. *International Journal of All Research Education and Scientific Methods*, *11*(03), 640–647. https://doi.org/10.56025/IJARESM.2023.11323640

Sinha, A., Devi, K. G., Kalra, S., Mani, K., Hari, P., & Bagga, A. (2024). An open label non-inferiority randomized controlled trial evaluated alternate day prednisolone given daily during infections vs. levamisole in frequently relapsing nephrotic syndrome. *Kidney International*, *105*(5), 1113–1123. https://doi.org/10.1016/j.kint.2024.01.028

Stevens, P. E., Ahmed, S. B., Carrero, J. J., Foster, B., Francis, A., Hall, R. K., Herrington, W. G., Hill, G., Inker, L. A., Kazancıoğlu, R., Lamb, E., Lin, P., Madero, M., McIntyre, N., Morrow, K., Roberts, G., Sabanayagam, D., Schaeffner, E., Shlipak, M., … Levin, A. (2024). KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney International*, *105*(4), S117–S314. https://doi.org/10.1016/j.kint.2023.10.018

Tonelli, M., Nkunu, V., Varghese, C., Abu-Alfa, A. K., Alrukhaimi, M. N., Fox, L., Gill, J., Harris, D. C. H., Hou, F. F., O'Connell, P. J., Rashid, H. U., Niang, A., Ossareh, S., Tesar, V., Zakharova, E., & Yang, C. W. (2020). Framework for establishing integrated kidney care programs in low- and middle-income countries. In *Kidney International Supplements* (Vol. 10, Issue 1, pp. e19–e23). Elsevier B.V. https://doi.org/10.1016/j.kisu.2019.11.002

Torabikhah, M., Farsi, Z., & Sajadi, S. A. (2023). Comparing the effects of mHealth app use and face-to-face training on the clinical and laboratory parameters of dietary and fluid intake adherence in hemodialysis patients: A randomized clinical trial. BMC Nephrology, 24, Article 194. https://doi.org/10.1186/s12882-023-03246-7

Trisnaningtyas, W., Indriyawati, N., Dwiningsih, S. U., Elisa, E., Ariyanti, N. A., & Maksuk, M. (2023). Faktor yang Mempengaruhi Kepatuhan Pembatasan Cairan pada Paisen Gagal Ginjal Kronis. *Health Information : Jurnal Penelitian*, *15*(2), e950. https://doi.org/https://doi.org/10.36990/hijp.v15i2.950

Vijay, V. R., & Kang, H. K. (2022). The worldwide prevalence of nonadherence to diet and fluid restrictions among hemodialysis patients: A systematic review and meta-analysis. Journal of Renal Nutrition, 32(6), 658–669. https://doi.org/10.1053/j.jrn.2021.11.007

Yasin, F., Khraim, F., Santos, M., Forgrave, D., & Hamad, A. (2024). Factors influencing self-care management in adult hemodialysis patients: An integrative review. Qatar Medical Journal, 2024(1), Article 12. https://doi.org/10.5339/qmj.2024.12