

Determinants of Fluid Restriction Adherence among Hemodialysis Patients: A Single-Center Cross-Sectional Study

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ABSTRACT

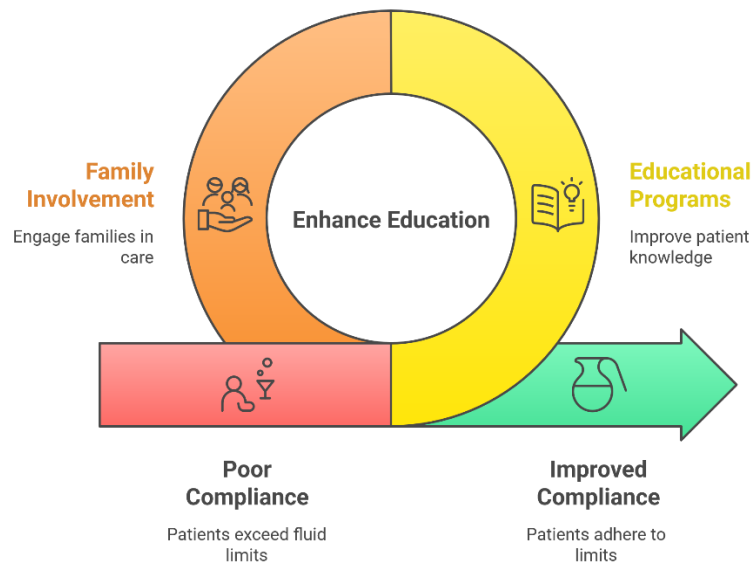
Fluid restriction compliance refers to a patient's adherence to the prescribed limit of fluid intake to maintain optimal health. This compliance is influenced by factors such as age, education level, family support, and knowledge. The purpose of this study was to explore how these factors impact fluid restriction adherence among hemodialysis patients. This correlational research used a cross-sectional design with a sample of 155 hemodialysis patients from Jampangkulon Regional Hospital, selected through proportional random sampling. Data were collected via a questionnaire and analyzed using chi-square and logistic regression. The study found that a majority of patients were compliant with fluid restrictions (71.0%), and most possessed good knowledge on the topic (80.6%). Bivariate analysis identified significant effects of age ($p=0.030$), education ($p=0.041$), family support ($p=0.015$), and knowledge ($p=0.001$) on compliance. After controlling for all factors in a logistic regression model, knowledge emerged as the sole statistically significant predictor of compliance ($p=0.028$). In conclusion, while age, education, family support, and knowledge were all correlated with adherence, knowledge was the most significant factor in predicting compliance. It is recommended that Jampangkulon Regional Hospital enhance educational programs and involve families in patient care to improve compliance.

Key Messages:

This study emphasizes the need for a holistic approach in patient care, where factors such as knowledge and family support are integrated into the treatment process to enhance patient compliance.

GRAPHICAL ABSTRACT

Improving Fluid Restriction Compliance



INTRODUCTION

Hemodialysis therapy is a crucial treatment for chronic kidney disease (CKD) patients, replacing kidney function through a device called a dialyzer. This treatment is typically performed one to two times a week for at least three months. In Indonesia, the prevalence of hemodialysis has significantly improved, with data from the Indonesian Renal Registry showing progress in several provinces since 2017, particularly with West Java achieving over 80% coverage (1,2)

Stage V CKD patients undergoing hemodialysis are at risk of experiencing abnormalities in nutritional and metabolic status, including protein-energy wasting (PEW), obesity, nutritional deficiencies, electrolyte disorders, and accumulation of metabolic waste (3). However, patients undergoing hemodialysis face various challenges, including malnutrition, gastrointestinal symptoms, urinary problems, fatigue, and difficulty sleeping (4). One of the most significant issues is fluid restriction. Without proper management, excessive fluid intake can lead to edema, increased blood pressure, and fluid buildup in the lungs, causing respiratory distress. This condition can result in a rapid weight increase, exacerbating the strain on the heart (5). Fluid restriction is still a major problem in the care of CKD patients undergoing hemodialysis programs, which can be a cause of death due to uncontrolled fluid intake problems (6).

Family support plays a significant role in enhancing fluid restriction compliance among CKD patients undergoing hemodialysis. Emotional and practical assistance from family members can motivate patients to follow treatment guidelines and make necessary lifestyle changes. Patients who feel supported by their families tend to be more compliant with fluid intake restrictions, as they do not feel alone in managing their condition (7). Factors such as age, education level, and family support significantly influence a patient's ability to follow these restrictions, highlighting the importance of a supportive environment for improving patient outcomes (8)

Compliance with fluid restrictions in CKD patients undergoing hemodialysis is significantly influenced by several factors, one of which is knowledge. Patients need to understand the limits of their fluid intake, as kidney failure reduces their ability to produce urine, leading to fluid accumulation in the body. This excess fluid can accumulate in critical areas like the heart, lungs, and legs, causing severe complications if not properly managed. Patients who are aware of the risks associated with fluid overload are more likely to comply with fluid restrictions, recognizing the potential for adverse effects if these guidelines are ignored (9).

Education plays a crucial role in improving patient compliance by enhancing their understanding and acceptance of health information, which is essential for effective disease management. Numerous studies

have demonstrated that educational interventions lead to better adherence to treatment plans for various medical conditions (10). Educating patients about fluid restrictions and their impact on health empowers them to adopt healthier behaviors and better manage their treatment. Patients with higher education levels and better health literacy are more likely to adhere to prescribed health behaviors, which can improve their overall health status (4).

Health literacy serves as a critical underlying mechanism through which both education and knowledge significantly influence the behaviors of patients undergoing hemodialysis. Health literacy encompasses the ability of individuals to access, understand, and apply health-related information effectively, which is vital for managing chronic conditions like kidney disease (11,12). Studies indicate that patients with higher health literacy levels are more adept at navigating the healthcare system, which correlates with improved self-management behaviors, such as adhering to treatment protocols including dietary restrictions and medication schedules (13,14).

Age is another important factor influencing compliance with fluid restrictions. Older patients tend to be more health-conscious and motivated to follow medical advice to increase their life expectancy. As individuals age, they become more aware of the importance of maintaining good health and are more likely to comply with treatments that help manage their condition (8). This heightened motivation can significantly impact adherence to fluid restrictions among elderly CKD patients.

RSUD Jampangkulon, a referral hospital in West Java, provides hemodialysis services with seven machines for patients with kidney failure. In March 2023, the hospital recorded 303 dialysis sessions, including both routine and initiation patients. A preliminary study conducted in the Hemodialysis room of the hospital revealed mixed compliance among patients. Some were consistent with their treatment, while others faced challenges such as long travel distances and lack of family support, which affected their adherence. These findings highlight the importance of understanding the factors influencing fluid restriction compliance and the need for further investigation into these factors at RSUD Jampangkulon.

METHODS

Design

This type of research is a correlational study with a cross-sectional approach. The cross-sectional approach is used to study the dynamics of the correlation between risk factors with effects simultaneously at a certain time. This method allows researchers to observe the relationship between factors that influence compliance with fluid restrictions in hemodialysis patients at Jampangkulon Regional Hospital, Sukabumi Regency in one data collection period.

Participant

The population in this study were all chronic kidney failure patients undergoing hemodialysis at Jampangkulon Regional Hospital. The inclusion criteria in this study included patients aged 18 years and over, patients with a diagnosis of chronic kidney disease requiring hemodialysis as a treatment method, and patients who had undergone hemodialysis procedures for at least three months. The exclusion criteria included patients with acute kidney disease who did not require hemodialysis, patients with a history of mental disorders that could hinder participation in the study, and patients with terminal medical conditions that could affect the results of the study. The sampling technique used was proportional random sampling to ensure a representative sample distribution. Based on the sample calculation, the number of respondents involved in this study was 155 people.

Questionnaire

The measuring instrument in this study was a questionnaire that included several research variables. Education level and age were measured based on the demographic characteristics of the respondents. The variables of family support, knowledge, and compliance with fluid restriction were measured using the Guttman scale, which was researcher-developed and validated for this study. A closed questionnaire was used for data collection. Compliance with fluid restriction was measured based on the questionnaire score, with the interpretation of "compliant" if the answer was "Yes" 7 times and "non-compliant" if fewer than 7 times. Family support was measured based on the frequency of family members' presence during hemodialysis sessions, the level of involvement in patient monitoring, and emotional

support provided. The interpretation of family support was classified as "supporting" if the score was >50 and "not supporting" if ≤ 50 . Patient knowledge of fluid restriction was assessed through the results of a knowledge test, with the interpretation of "good" if the score was >7 and "poor" if ≤ 7 . Measurement of education level was carried out based on the last level of education completed by the patient, while age was measured in complete years during the hemodialysis session. Validity tests showed that all question items in the family support, knowledge, and compliance variables had a p-value <0.05 , which means valid. Reliability tests show that the family support variable questionnaire has very strong reliability (0.917), the knowledge variable has strong reliability (0.760), and the fluid restriction compliance variable has quite strong reliability (0.677).

Data collection procedures

Data were collected using a closed questionnaire method that had been tested for validity and reliability. The questionnaire was given directly to the respondents, who then filled it out according to their circumstances. This method was chosen because it was efficient in terms of time and energy and provided respondents with the freedom to fill out the questionnaire without feeling disturbed. The data collected included the characteristics of the respondents and the factors that influenced compliance with fluid restrictions in hemodialysis patients.

Data analysis

Data analysis was performed using SPSS software version 26.0 for Windows. Univariate analysis was performed to describe the characteristics of respondents and the distribution of research variables using frequency distribution with categorization based on the median. Bivariate analysis was performed using the Chi-square test (χ^2) to test the relationship between independent variables (family support, knowledge, education level, and age) with the dependent variable (fluid restriction compliance). The decision of the Chi-square test is based on a two-way hypothesis with an error rate of 5%, namely H_0 is rejected if the p-value <0.05 indicating a relationship between the independent variable and the dependent variable, and H_0 is accepted if the p-value ≥ 0.05 indicating no significant relationship. For further analysis, logistic regression analysis was performed to determine the dominant factors influencing fluid restriction compliance in hemodialysis patients.

Ethical Considerations

This study has been approved by the STIKES Sukabumi Research Ethics Committee and is carried out in accordance with the principles of research ethics (No:00300/KEP STIKES SUKABUMI/2023).

RESULTS

Based on table 1, the majority of respondents in this study were women, with a total of 85 people or 54.8% of the total respondents. In addition, most respondents had an unemployed status, as many as 80 people or 51.6%. In terms of income, the majority of respondents reported earning more than 1,000,000, which was 90 people or 58.1%. The majority of respondents also under 60 years old, as many as 135 people or 87.1%. Finally, the majority of respondents had a final education of high school to college, as many as 95 people or 61.3%.

Table 1. Participant Characteristics

Characteristics	Category	n	%
Gender	Male	70	45.2
	Female	85	54.8
Employment Status	Entrepreneur/Trader	75	48.4
	Unemployed	80	51.6
Income	$< 1,000,000$	90	58.1
	$\geq 1,000,000$	65	41.9
Age	< 60 years	135	87.1
	≥ 60 years	20	12.9
Education	Elementary – Middle School	60	38.7
	High School - PT	95	61.3

Table 2 shows that there is a significant relationship between age and patient compliance ($p = 0.030$). Patients aged <60 years were 4.71 times more likely to be adherent compared to patients aged ≥ 60 years ($OR = 4.710$). Education level was also significantly related to compliance ($p = 0.041$). Patients with higher education (SMA-College) have a 4.178 times greater chance of complying than patients with low education (SD-SMP) ($OR = 4.178$). Family support plays an important role in patient compliance, with results showing that patients who receive family support are 5.862 times more likely to comply compared to patients who do not receive support ($p = 0.015$; $OR = 5.862$). Patient knowledge also has a significant relationship with adherence ($p = 0.001$), with patients who have good knowledge having a 10.648 times greater chance of complying compared to patients who have poor knowledge ($OR = 10.648$).

Table 2. Bivariate Analysis between Demographic Variables and Compliance

Demographic Variables	Category	Compliance	n	P-Value	Odds Ratio (OR)
Age	< 60 years	Compliant	105	0.030	4,710
		Non-Compliant	30		
	≥ 60 years	Compliant	5		
		Non-Compliant	15		
Education	Elementary-Middle School	Compliant	30	0.041	4.178
		Non-Compliant	30		
	High School-College	Compliant	80		
		Non-Compliant	15		
Family Support	Support	Compliant	95	0.015	5,862
		Non-Compliant	20		
	No Support	Compliant	15		
		Non-Compliant	25		
Knowledge	Good	Compliant	105	0.001	10,648
		Non-Compliant	20		
	Poor	Compliant	5		
		Non-Compliant	25		

Table 3. Modeling of the Influence of Age, Education, Family Support, and Knowledge on Fluid Restriction Compliance

Variables	B	P-Value	OR
Age	-2.351	0.160	0.095
Education	1,567	0.236	4.795
Family Support	-2,399	0.081	0.091
Knowledge	-3.469	0.028	0.031
constant	4,520	0.081	91,857

R Square = 0.643

Based on Table 3, the Nagelkerke R Square value of 0.643 indicates that the combination of variables—age, education, family support, and knowledge—explains 64.3% of the variance in fluid restriction compliance, while the remaining 35.7% is attributed to other factors not included in the model. The results of the multivariate logistic regression analysis reveal that only one variable, *knowledge* ($p = 0.028$; $OR = 0.031$), is statistically significantly associated with compliance to fluid restrictions. This indicates that for each unit increase in knowledge, the likelihood of complying with fluid restrictions decreases by a factor of 0.031, which is a significant relationship. In contrast, *age* ($p = 0.160$; $OR = 0.095$), *education* ($p = 0.236$; $OR = 4.795$), and *family support* ($p = 0.081$; $OR = 0.091$) do not have statistically significant associations with fluid restriction compliance in this model. While these variables showed some influence in bivariate analyses, they are not statistically significant predictors after adjusting for the other

variables in the model. The most critical finding is that, after controlling for all variables, *knowledge* remains the only significant predictor of compliance with fluid restrictions. Therefore, the earlier claim that education is the "most dominant variable" should be revised, as its p-value (0.236) indicates that it is not statistically significant at the conventional $\alpha < 0.05$ level. In conclusion, although age, education, and family support may have an impact on fluid restriction compliance, these effects are not statistically significant in the multivariate model, and the only statistically significant factor is knowledge.

DISCUSSION

The results of this study revealed that knowledge was the most significant predictor of patient compliance with fluid restrictions in hemodialysis patients, whereas factors such as age, education, and family support did not show significant influence in the multivariate model. This finding shifts the focus from conventional assumptions about the direct impact of education and family support to a more nuanced understanding that knowledge itself is the key determinant. A study by Marbun emphasizes that patient education through counseling and dietary journaling enhances knowledge and correlates with improved compliance among renal failure patients on hemodialysis (15). Similarly, Fauzi and Oktaviani illustrate that repeated nutrition-based education significantly elevates patients' understanding of dietary requirements, suggesting that increased knowledge translates into better adherence to dietary restrictions, including fluid intake compliance (16). This underscores the idea that knowledge entails understanding the consequences of non-compliance, thereby motivating patients to adhere to recommended fluid restrictions. In examining the indirect influences of factors such as education and family support, Mananawan and Rosa argue that while education enhances a patient's capability to manage their health, it is ultimately the patient's understanding of their condition that governs adherence to treatment (17). Furthermore, Sari et al. observe that increasing social and familial support can enhance patient compliance; however, this support is most effective when supplemented with a solid foundation of knowledge regarding the necessity of compliance, thus highlighting knowledge as a crucial precursor to effective engagement with family support systems (18).

Although education was found to be a significant predictor of compliance in the univariate analysis, it did not retain its significance in the multivariate model (p-value > 0.05). In this study, 61.3% of respondents had completed high school or university, while 38.7% had completed elementary or junior high school. This discrepancy suggests that the effect of education on compliance may be mediated by knowledge. In other words, while higher educational attainment can improve a person's ability to process and understand information, it is the knowledge gained through that education that directly influences patient behavior and adherence to fluid restrictions. Knowledge is also everything that a person knows based on his own personal experience and that knowledge will always increase through processes that occur and are experienced directly (19). Several studies highlight the significant role of education in promoting self-management and improving patient adherence to health regimens. For example, Tekin and Büber (2024) found that higher educational attainment enhances patients' ability to comprehend health-related information, which in turn leads to better self-care practices (20). This is in line with Kolasa et al. (2021), who emphasized that educational interventions directly improve compliance by transforming patient behavior (21). Additionally, Chen et al. (2020) demonstrated that patient education before discharge from healthcare facilities is crucial in ensuring adherence to self-care practices (22). Despite the majority of patients having some level of formal education, it was their knowledge about the disease and its management that more directly influenced their compliance with fluid restrictions. Health literacy, which is the ability to acquire, understand, and apply health-related information, plays a crucial role in shaping health behaviors and outcomes. Studies have repeatedly shown a strong correlation between health literacy and various health-related behaviors. For instance, higher health literacy levels are associated with healthier lifestyle choices, such as reduced alcohol consumption, smoking, and increased physical activity, particularly among adolescents and those with chronic diseases (23–25). In public health, low health literacy is a significant barrier to good health and is often linked to poor health outcomes and increased healthcare costs. This highlights the need for interventions to improve health literacy across

different populations. Therefore, health literacy may be a more decisive factor than formal educational attainment in determining whether patients follow medical recommendations. Health literacy plays a crucial role in enabling patients to comprehend potential health risks and make informed health decisions. It involves the capacity to access, process, understand, and use health-related information to influence health decisions positively (26,27). Higher health literacy is directly correlated with improved health outcomes, as individuals with better health literacy are more likely to manage their health effectively and adhere to treatment plans (27,28).

The study's findings underscore that knowledge is the most significant predictor of compliance with fluid restrictions (p -value = 0.028, OR = 0.031). The 80.6% of respondents in this study who demonstrated good knowledge about hemodialysis and fluid restrictions were significantly more likely to adhere to the prescribed fluid intake recommendations. Knowledge about the disease, medical procedures, and the risks associated with fluid overload enables patients to make informed decisions about their health, even after controlling for other variables such as age, education, and family support. In patients with chronic kidney disease (CKD) undergoing hemodialysis understanding the significance of fluid restriction is critical to managing their health. Fluid overload can lead to serious health complications such as hypertension, edema, and heart failure, which is well documented in the literature. For instance, emphasize that knowledge of these risks fosters a deeper understanding among patients regarding the detrimental effects of non-compliance with fluid intake guidelines. This understanding aligns closely with the The Health Belief Model (HBM), developed by Rosenstock in 1974, posits that individual health behaviors are significantly influenced by their perceptions of health risks and the effectiveness of preventive measures. In the context of fluid overload, individuals are more likely to engage in health-promoting behaviors if they perceive a serious threat from their condition and believe that taking action will mitigate that threat. This model emphasizes that perceived severity, perceived susceptibility, perceived benefits, and perceived barriers are critical factors in determining health-related actions (29). Thus, educational interventions aimed at improving patient knowledge about fluid management are invaluable in enhancing adherence to fluid restrictions, thereby reducing complications associated with CKD.

Education is a fundamental component of improving adherence to fluid restrictions among patients with end-stage kidney disease (ESKD). Research indicates that patients with a higher understanding of their dietary and fluid restrictions demonstrate significantly better adherence to guidelines. Evidence shows that knowledge about the health implications of non-compliance, including potential hospital readmissions and a decline in health status, directly enhances patients' motivation to follow fluid limitations (30,31). This finding emphasizes the need for targeted health education programs that not only provide information but also ensure that patients understand the content. Educational programs that enhance knowledge about hemodialysis, the importance of fluid restrictions, and the risks of non-compliance are essential to improving patient outcomes. This approach should focus on ensuring that patients can apply the information they have learned in their daily lives, making it a practical and actionable part of their routine. Research indicates that health education programs can significantly impact patients' understanding of their health conditions. Alazwari et al. highlight that effective program design, utilizing a socioecological framework, allows health education to address various levels of influence on health behavior, thus fostering better comprehension and application of health information among patients (32). This is further echoed by Suryasa et al., who assert that health education plays a critical role in disease prevention and health promotion, emphasizing the necessity for programs that are both informative and practical (33).

In this study, 74.2% of respondents reported receiving family support, which is often considered a key element in patient education. However, while family support did not emerge as a significant predictor of compliance in the multivariate model (p -value > 0.05), it likely plays a supportive role in reinforcing the patient's knowledge and adherence behaviors. Family members can help remind patients about their fluid restrictions, which strengthens the patient's resolve and enhances the application of what they have learned. Similarly, Alatawi et al. (2024) elaborated on the association between perceived social support and adherence levels among patients undergoing hemodialysis, demonstrating that robust support networks contribute to higher adherence rates to medical recommendations (34). Although family support

did not directly affect compliance in the multivariate model, it still played a role in helping patients manage their health conditions. Family support can act as an additional layer of reinforcement to the knowledge that patients gain through formal education programs. Family support is closely related to supporting a person's quality of life. This is because the quality of life is a perception that is present in the abilities, limitations, symptoms and psychosocial characteristics of an individual's life both in the context of the cultural environment and its value in carrying out its roles and functions properly (35). In this study, 74.2% of respondents received supportive family care, which highlights the importance of having a support system that can assist patients in adhering to the treatment regimen. Families are often an integral part of patients' daily lives, and thus have a significant influence in helping patients adhere to treatment recommendations, such as diet, medication schedules, and blood sugar monitoring. Education involving families not only increases their knowledge of the disease but also strengthens emotional and practical support for patients (36)

The interrelationship between age, education, family support, and knowledge further highlights the complexity of factors influencing patient compliance. For example, older patients, who may face cognitive challenges, could benefit from increased knowledge to help them manage their disease despite the cognitive difficulties associated with aging. In this study, 87.1% of respondents were under 60 years old, which may explain why age did not significantly impact compliance, as younger patients may have better cognitive function and capacity for learning. Moreover, while education alone did not significantly affect compliance, patients who were better educated may have had a stronger ability to comprehend the health information they received. This reinforces the hypothesis that education's effect on compliance is mediated through knowledge acquisition, rather than education acting alone as a direct predictor of behavior. Improving knowledge of disease management, older individuals may experience behavioral improvements that can alleviate the emotional and social impacts of their conditions (37). Additionally, other studies support the notion that empowering older adults with knowledge about their condition enhances their ability to manage their health proactively, which could be integral in fostering independence and improving outcomes (38)

In managing hemodialysis patients, prioritizing patient education is essential, particularly regarding the risks and consequences of fluid overload—a prevalent issue linked to increased morbidity and mortality. Excessive fluid accumulation can lead to serious complications such as pulmonary edema and cardiovascular events, making effective fluid management a critical aspect of care. To address this, healthcare providers must implement comprehensive, interdisciplinary educational interventions that go beyond merely sharing information; they must ensure that patients fully understand, retain, and apply strategies for fluid restriction in their daily lives. Studies have shown that tailored educational programs, including virtual approaches introduced during the pandemic, significantly improve patients' adherence to dietary and fluid intake guidelines, resulting in better health outcomes (39–41). In clinical practice, this underscores the need for collaborative education involving nephrologists, nurses, and dietitians to empower patients through improved health literacy and sustained behavioral change.

The involvement of family members in the educational process within healthcare settings has proven to be highly important, particularly in supporting hemodialysis patients in maintaining treatment adherence. Family participation can enhance patient compliance by providing additional information, emotional reinforcement, and a stronger understanding of healthcare practices, enabling patients to manage their health more effectively. Education that includes family members not only improves the quality of information received but also helps create a safe environment for patients in making health-related decisions (42). This approach is especially beneficial for vulnerable groups such as the elderly, who often require extra support to remain consistent with their treatment. A study by Mansour et al. (2022) showed that patients who received self-care education involving their families exhibited greater knowledge, awareness, and self-efficacy, resulting in improved adherence to treatment regimens (43). These findings underscore the need for healthcare providers to adopt a collaborative approach that engages both patients and their families, ensuring that the support system aligns with treatment goals and contributes to optimal clinical outcomes.

The study was conducted in a single hospital setting, which may limit the generalizability of the findings to other healthcare facilities or populations. The study relied on self-reported data, which may be subject to recall bias or social desirability bias, potentially affecting the accuracy of responses. This study only examined four independent variables, while other factors such as psychological aspects, economic conditions, and healthcare provider roles were not analyzed, which may also influence compliance with fluid restrictions. Based on the results of this study, several suggestions can be given

CONCLUSION

This study highlights that while multiple factors are correlated with fluid restriction adherence in hemodialysis patients, knowledge about fluid restriction is the most significant predictor when all factors are considered together. Although age, education, and family support were found to be associated with compliance in bivariate analyses, they did not remain statistically significant in the multivariate model, with knowledge being the only significant factor. These findings suggest that, contrary to previous assumptions that education was the dominant factor, the most crucial element influencing adherence is the patient's understanding of fluid restriction. Therefore, the study recommends that healthcare providers prioritize enhancing patient knowledge through targeted educational interventions, with an emphasis on involving family members in the educational process to improve compliance and overall patient outcomes in hemodialysis care.

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CONFLICTS OF INTEREST

There is no conflict of interest among researchers in this study.

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