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# Adherence to Hemodialysis Therapy Among Adult Patients with Chronic Kidney Failure: A Study at Dr. Moewardi General Hospital Surakarta

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**ABSTRACT:** Chronic kidney failure is a clinical syndrome caused by various chronic kidney diseases, characterized by imbalanced water, electrolyte and acid-base metabolism. Hemodialysis separates uremic substances from blood through a semipermeable membrane in an artificial kidney called a dialyzer. Adherence refers to an individual's behavior in following treatment rules, guidelines, and discipline, including medication compliance, dietary recommendations, and lifestyle changes as recommended by treatment and health advice. This study analyzes adherence levels among adult patients with chronic kidney failure undergoing hemodialysis therapy at Dr. Moewardi General Hospital, Surakarta. This analytic-observational quantitative study used cross-sectional methods with prospective purposive sampling. Data collection used closed questionnaires from February to March 2025. Results demonstrated that the majority of patients were 40-60 years old, male, with a high school education, with a hemodialysis duration of 1-5 years, and who relied on hospital-set schedules. Analysis revealed relationships between adherence and patient profiles, including age, educational level, and duration of hemodialysis.

**Keywords**: Chronic kidney failure, Hemodialysis, Adherence

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## INTRODUCTION

Chronic kidney disease is a clinical syndrome characterized by imbalances in water, electrolytes, and acid-base homeostasis, with progression leading to impaired kidney function and uremia lasting more than 3 months (Wen et al., 2022). Chronic kidney disease occurs in individuals with creatinine clearance rates below 50 mL/minute or 0.83 mL/second (DiPiro et al., 2020). According to Riskesdas survey results, chronic kidney failure prevalence in Indonesia is 0.38% or 3.8 cases per 1,000 people, with more than 60% reaching end-stage requiring hemodialysis treatment (Kemenkes RI, 2023). The disease is more common in men (0.42%) than women (0.35%), with 19.33% or 2,850 patients not yet undergoing hemodialysis therapy (Kemenkes RI, 2020). Riskesdas reported Central Java's chronic kidney disease prevalence in 2020 at 17.3% of 34 provinces, ranking eighteenth (Riskesdas, 2020). Based on 2024 annual report data from the hemodialysis unit at Dr. Moewardi General Hospital in Surakarta, 1,508 patients underwent hemodialysis therapy from April to June 2024.

Although previous studies examined hemodialysis adherence in Indonesia (Pakpahan et al., 2024; Susantri et al., 2022; Laksono et al., 2019), they primarily reported general adherence rates without detailed hospital-specific profiling of adherence patterns and determinants, and yielded inconsistent findings regarding sociodemographic predictors such as age and education level. Most studies investigated single factors rather than simultaneously analyzing various sociodemographic variables, limiting understanding of the complex interactions that influence adherence. Research on adherence patterns in Central Java tertiary hospitals remains scarce, despite regional variations in health resources, patient populations, and cultural contexts that could yield distinct patterns and barriers. This study fills that gap by providing specific data from Dr. Moewardi General Hospital Surakarta as a major tertiary referral center in Central Java, analyzing various sociodemographic factors (age, gender, education level, and duration of hemodialysis) and their relationship with adherence behavior, producing actionable evidence to develop context-appropriate adherence improvement programs tailored to barriers faced by patients in similar healthcare facilities in Indonesia.

This study addresses the need for comprehensive adherence profiling in the Indonesian hemodialysis context by simultaneously examining multiple sociodemographic factors—age, gender, education level, and duration of hemodialysis—and their associations with adherence behavior using validated instruments, unlike previous studies that reported general adherence rates or examined single factors in isolation. The high volume of hemodialysis patients at Dr. Moewardi General Hospital Surakarta (1,508 patients from April to June 2024) as a major tertiary referral center serving Central Java underscores the urgent need to assess and address adherence, as non-adherence directly translates into serious clinical consequences including uremic toxin accumulation, fluid overload, electrolyte imbalances, and increased cardiovascular complications, while contributing to increased emergency visits, unplanned hospitalizations, and higher healthcare costs. Understanding adherence determinants in this high-volume setting is critical to developing evidence-based interventions that improve patient outcomes while optimizing resource utilization. Without a systematic assessment of adherence patterns and their predictors, healthcare providers lack the data needed to design targeted, context-appropriate interventions that address specific barriers faced by their patient population.

## METHODS

This study employs a cross-sectional analytical design using the validated End-Stage Renal Disease Adherence Questionnaire (ESRD-AQ), a six-item instrument covering key adherence dimensions relevant to hemodialysis patients, to systematically assess adherence levels and examine associations with sociodemographic characteristics, allowing simultaneous examination of multiple variables and providing a more comprehensive understanding than single-factor analyses in previous studies. Prior to data collection, validity testing using Pearson correlation analysis showed five of six items achieved r-values exceeding the critical threshold. In contrast, item 1 was retained based on content validity considerations (Syamsiah, 2011), and reliability testing yielded a Cronbach's alpha of 0.762, substantially exceeding the 0.70 threshold (Nunnally & Bernstein, 1994) and demonstrating psychometric adequacy comparable to other hemodialysis adherence studies (Kim et al., 2010; Saran et al., 2003).

The ESRD-AQ scoring categorizes adherence into adherent (score ≥ 800) and non-adherent (score < 800) based on weighted points assigned to six dimensions: frequency of missed hemodialysis sessions (0-300 points), frequency of shortened dialysis sessions (0-200 points), duration of time shortened (0-100 points), medication non-adherence (0-200 points), fluid restriction adherence (0-200 points), and dietary restriction adherence (0-200 points), with maximum total score of 1,200 points (Kim et al., 2010). The threshold of 800 points represents adherence to at least two-thirds of recommended behaviors across all six dimensions, ensuring clinical meaningfulness while maintaining adequate sensitivity and specificity for identifying patients at risk of non-adherence complications, validated in previous Indonesian hemodialysis studies (Syamsiah, 2011; Desvi, 2022) and aligning with clinical practice guidelines emphasizing consistent adherence across multiple behavioral domains rather than perfection in single areas.

This study aims to describe the adherence profile of adult hemodialysis patients at Dr. Moewardi General Hospital Surakarta, examine associations between sociodemographic characteristics (age, gender, education level, duration of hemodialysis) and adherence levels, and identify patient subgroups at higher risk of non-adherence to inform targeted intervention strategies. This cross-sectional analytical design is appropriate for identifying associations between patient characteristics and adherence; however, exposure and outcome are measured simultaneously, precluding the establishment of temporal precedence and causal inference. Therefore, identified associations should be interpreted as correlational rather than causal relationships.

Inclusion criteria were respondents who were able to communicate well, willing to participate by signing informed consent, and aged ≥ 19 years. In contrast, exclusion criteria were patients with cognitive impairment affecting their ability to accurately recall and report adherence behaviours and patients with psychiatric disorders interfering with their comprehension of study procedures, ensuring participants can provide reliable self-reported adherence data while maintaining ethical protections. Data were analyzed using descriptive statistics (frequency distributions and percentages) and bivariate analysis (Pearson's chi-square test) to examine associations between patient characteristics and adherence status, with chi-square test assumptions verified by confirming expected frequencies met minimum threshold of 5, categories collapsed when needed, statistical significance set at $p < 0.05$, and all analyses performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA).

Sample size was determined using the Slovin formula with a 10% margin of error, yielding $n = 1{,}508 / (1 + 1{,}508 \times 0.10^2) = 93.78 \approx 94$ respondents, rounded to 100 to account

for potential incomplete responses (Machali, 2021; Naing et al., 2006; Suresh & Chandrashekara, 2012). This sample size is adequate for descriptive analysis and chi-square testing, ensuring expected cell frequencies meet the minimum requirement of 5 for valid analysis (McHugh, 2013) and providing adequate statistical power for detecting moderate effect sizes (Cohen, 1988).

## RESULT AND DISCUSSION

The predominance of patients in pre-retirement and retirement age groups (49-60 years, 45%) raises important implications for adherence support systems, as this demographic may face unique challenges including declining functional capacity affecting transportation to dialysis centers, increased comorbidities requiring complex medication regimens, potential cognitive decline affecting self-management abilities, and economic vulnerability due to reduced working capacity, suggesting healthcare providers should implement age-stratified adherence interventions such as enhanced caregiver involvement for elderly patients, simplified medication schedules, and transportation assistance programs. The substantial representation of working-age adults (39-48 years, 33%) also highlights the need for flexible dialysis scheduling to accommodate employment, as maintaining employment can positively influence adherence through preserved social roles and economic stability (Tahir et al., 2024).

### 1. Univariate Analysis

The gender distribution showed moderate male predominance (55% vs 45%), consistent with global epidemiological patterns of chronic kidney disease, which may reflect a higher prevalence of risk factors among males, including systemic diseases (diabetes mellitus, hypertension) and lifestyle behaviors contributing to kidney damage (Yatilah & Hartanti, 2021). This relatively balanced distribution has important programmatic implications, as research suggests gender-specific barriers to adherence: males may underutilize healthcare services due to traditional masculine norms emphasizing self-reliance and stoicism, potentially leading to delayed help-seeking and lower adherence to dietary/fluid restrictions, while females, particularly those with caregiving responsibilities, may face competing demands that compromise treatment attendance. Gender-sensitive interventions should address these distinct barriers—for example, providing peer support groups addressing masculine identity concerns for male patients while offering flexible scheduling and childcare support for female patients with family obligations—and the balanced distribution suggests facility resources should be equitably allocated and adherence interventions designed to address both male and female patient populations rather than focusing predominantly on one gender (Agustina et al., 2021). The characteristics of respondents based on age, gender and education is displayed in Table 1, 2 and 3.

**Table 1.** Characteristics of Respondents Based on Age

| No | Age | N | (%) |
|---|---|---|---|
| 1. | 19-28 Years old | 9 | 9% |
| 2. | 29-38 Years old | 13 | 13% |
| 3. | 39-48 Years old | 33 | 33% |
| 4. | 49-60 Years old | 45 | 45% |
| | **Total** | 100 | 100% |

**Table 2.** Characteristics of Respondents Based on Gender

| No | Gender | N | (%) |
|---|---|---|---|
| 1. | Male | 55 | 55% |
| 2. | Female | 45 | 45% |
| | **Total** | 100 | 100% |

**Table 3.** Characteristics of Respondents Based on Education

| No | Education | N | (%) |
|---|---|---|---|
| 1. | No schooling | 9 | 9% |
| 2. | Elementary school | 19 | 19% |
| 3. | Junior high school | 23 | 23% |
| 4. | Senior high school | 35 | 35% |
| 5. | Higher education | 14 | 14% |
| | **Total** | 100 | 100% |

Educational levels distributed across all categories from no formal education (9%) to university degree (14%), with high school education as modal category (35%) and substantial proportion having low educational attainment (28% with primary school or less), highlighting need for health literacy-appropriate adherence interventions tailored to varying levels of understanding (Fitriyanal & Susilowati, 2025). This educational heterogeneity has critical implications for patient education approaches, as patients with limited formal education face documented challenges in understanding medical terminology, interpreting laboratory results, and following complex treatment regimens that directly impact adherence, suggesting healthcare providers should implement tiered educational strategies including visual aids and demonstration-based teaching for lower-literacy patients, written materials with enhanced graphics for middle-literacy groups, and detailed self-management resources for higher-education patients. The presence of university-educated patients (14%) also represents an opportunity, as these individuals could serve as peer educators or patient advocates, bridging communication gaps between healthcare providers and lower-literacy patients. At the same time, education-stratified adherence assessments may reveal that non-adherence in lower-education groups stems from comprehension barriers rather than motivational deficits, necessitating enhanced teach-back methods and family caregiver involvement (Agustina et al., 2021).

The temporal distribution revealed that most patients (84%) had been on treatment for 5 years or less, with 51% in the 1-5 year range and 33% for less than 1 year, while only 16% had undergone hemodialysis for more than 5 years. This distribution has several critical implications: the high proportion of patients in early treatment phases represents critical window for establishing adherence behaviors before patterns become entrenched, as newly diagnosed patients often experience psychological adjustment challenges including denial, anxiety, and depression that can manifest as non-adherence, suggesting intensive structured orientation programs during first year—including peer mentoring, psychological support, and gradual skill-building—may prevent development of non-adherent behaviors. The small proportion of long-term patients (16%) may reflect high

early mortality, successful transplantation, or transfer to other facilities. If early mortality is a significant factor, it underscores the urgency of ensuring adherence during the initial treatment phases. In contrast, long-term survivors may face different challenges, including treatment fatigue, cumulative side effect burden, and declining vascular access quality, requiring sustained re-engagement rather than initial education. From a service planning perspective, concentration of recent-onset patients suggests either expanding dialysis access in the region or high incident CKD rates, both requiring different resource allocation strategies and development of stage-specific adherence protocols matching distinct needs of initiation (<1 year), maintenance (1-5 years), and long-term (>5 years) phases (Pakpahan et al., 2024; Iswara & Mufihatin, 2021). Characteristics of respondents based on duration of hemodialysis therapy can be seen in table 4.

**Table 4.** Characteristics of Respondents Based on Duration of Hemodialysis Therapy

| No | Start of HD | N | (%) |
|---|---|---|---|
| 1. | < 1 Year | 33 | 33% |
| 2. | 1-5 Year | 51 | 51% |
| 3 | > 5 Year | 16 | 16% |
| | **Total** | 100 | 100% |

Patients demonstrated a two-tiered approach to scheduling, with two-thirds (66%) relying primarily on hospital schedules and one-third (34%) relying on family reminders, revealing both institutional dependency and the critical role of social support systems in maintaining treatment continuity. The heavy reliance on hospital-provided schedules suggests generally effective institutional communication systems yet also reveals potential vulnerability, as patients may struggle to maintain adherence if hospital communication systems fail or if they need to transfer care to other facilities, potentially reflecting limited patient activation or self-management skills. The significant minority relying on family reminders (34%) highlights the essential role of informal caregivers in the treatment process but also raises equity concerns, as patients without supportive family networks may be systematically disadvantaged in maintaining adherence. The complete absence of technology-based reminder methods (smartphone apps, SMS reminders, digital calendars) is particularly notable, and barriers to technology adoption may include limited digital literacy, especially among older patients (78% aged 39+), cost concerns, lack of awareness of available tools, or preference for human interaction over automated systems. Healthcare facilities should explore introducing low-cost, user-friendly digital reminder systems, such as automated SMS or WhatsApp messages, while simultaneously providing training and support to bridge the digital divide. For patients without digital access or literacy, enhanced family caregiver training and community health worker home visits could provide alternative support structures. Critically, facilities should identify and provide additional support for patients who have neither reliable family support nor comfort with institutional systems, as this group likely faces the highest adherence barriers.

**Table 5.** Characteristics of Respondents Based on Method of Remembering Hemodialysis Schedule

| No | Method of Remembering HD Schedule | N | (%) |
|---|---|---|---|
| 1. | Hospital schedule | 66 | 66% |
| 2. | Family | 34 | 34% |
| | **Total** | 100 | 100% |

Overall, adherence rates showed that nearly three-quarters (72%) of patients achieved adherence, while more than one-quarter (28%) remained non-adherent despite ongoing treatment. While this adherence rate appears favorable compared to some regional studies (Puspitasari, 2024: 57%), the substantial non-adherent minority represents a clinically significant population at elevated risk for complications and mortality. The 28% non-adherence rate translates into substantial absolute numbers, as non-adherence in hemodialysis carries particularly severe consequences, including inadequate toxin removal, fluid overload, electrolyte imbalances, and accelerated cardiovascular deterioration. Epidemiological studies demonstrate that non-adherent hemodialysis patients experience a 2-3 times higher mortality risk than adherent patients.

From a healthcare system perspective, non-adherence generates cascading costs, including increased emergency department visits for urgent dialysis, hospitalizations for fluid overload and electrolyte complications, and intensive care admissions. Moreover, at Dr. Moewardi General Hospital Surakarta, serving 1,508 patients over three months, a 28% non-adherence rate implies approximately 422 patients requiring enhanced adherence interventions, necessitating systematic, resource-efficient approaches rather than individualized intensive counselling. The bivariate analyses that follow will reveal whether non-adherence clusters in identifiable demographic subgroups. If clear risk profiles emerge, stratified interventions become feasible with high-risk groups receiving intensive proactive support. In contrast, lower-risk groups receive standard education, whereas if non-adherence is relatively evenly distributed across demographic categories, it suggests adherence barriers stem from universal factors requiring population-level interventions (Susantri et al., 2022; Puspitasari, 2024).

**Table 6.** Characteristics of Respondents Based on Compliance

| No | Compliance | N | (%) |
|---|---|---|---|
| 1. | Compliance | 72 | 72% |
| 2. | Non-compliant | 28 | 28% |
| | **Total** | 100 | 100% |

The identification of this at-risk group becomes particularly important when considered alongside demographic and clinical heterogeneity observed, suggesting targeted interventions may need to address multiple factors simultaneously rather than single risk factors in isolation, as adherence to hemodialysis therapy is influenced by various factors, including age, education level, occupation, gender, attitude, behavior, and support from family and healthcare professionals. At the same time, non-compliant patients often feel their physical condition is healthy enough to manage daily lives without hospital care, which may be located far from their residence. Lengthy duration of hemodialysis sessions often leads to boredom, while patients with busy work schedules struggle to adhere to scheduled times, resulting in missed sessions (Susantri et al., 2022; Sumah, 2020).

## 2. Bivariate Analysis

The relationship between age and compliance of chronic kidney failure patients in undergoing hemodialysis therapy can be seen in table 7. The p-value of 0.001 (<0.05) indicates significant association between age and compliance among adult patients with chronic kidney disease undergoing hemodialysis therapy at Dr. Moewardi General Hospital

in Surakarta, with all expected cell frequencies in chi-square analysis exceeding 5, confirming statistical assumptions were met, and these results align with research by Anwar (2022) which showed significant relationship between age and compliance with hemodialysis therapy. The observed association between older age and decreased adherence may be attributed to several underlying mechanisms rather than chronological age itself, as age-related physical decline and fatigue can significantly impact patients' ability to maintain demanding hemodialysis schedule, with older patients often experiencing reduced energy levels and physical stamina that make thrice-weekly, multi-hour dialysis sessions particularly burdensome (DiPiro et al., 2020), while accumulation of comorbidities with advancing age presents additional challenges to adherence, as patients in 49-60 age group commonly present with multiple chronic conditions such as diabetes mellitus, hypertension, and cardiovascular disease that complicate disease management and may lead to polypharmacy, increasing treatment complexity and potentially overwhelming patients' self-management capacity (Hasanah et al., 2023).

**Table 7.** Relationship between Age and Compliance of Chronic Kidney Failure Patients in Undergoing Hemodialysis Therapy

| No | Age | Compliant | Non-compliant | *p-value* |
|---|---|---|---|---|
| 1. | 19-28 Years | 9 | 0 | |
| 2. | 29-38 Years | 10 | 3 | 0,001 |
| 3. | 39-48 Years | 26 | 7 | |
| 4. | 49-60 Years | 27 | 18 | |
| | **Total** | 72 | 28 | 100 |

Additionally, age-related cognitive changes including mild cognitive impairment and declining executive function may affect patients' ability to remember appointments, follow complex medication regimens, and maintain dietary restrictions (Wen et al., 2022), while socioeconomic factors associated with aging—such as retirement-related income reduction, decreased mobility, and loss of social support networks—may create practical barriers to consistent treatment attendance, highlighting need for age-appropriate interventions addressing not only biological aspects of aging but also psychosocial and practical challenges, and healthcare providers should consider comprehensive assessments of older patients' physical capacity, cognitive function, comorbidity burden, and social support systems when developing individualized adherence enhancement strategies. The relationship between gender and compliance of chronic kidney failure patients in undergoing hemodialysis therapy can be seen in table 8.

**Table 8.** Relationship between Gender and Compliance of Chronic Kidney Failure Patients in Undergoing Hemodialysis Therapy

| No | Gender | Compliant | Non-compliant | *p-value* |
|---|---|---|---|---|
| 1. | Male | 39 | 16 | 0,128 |
| 2. | Female | 33 | 12 | |
| | **Total** | 72 | 28 | 100 |

The p-value of 0.128 (>0.05) indicates no statistically significant association between gender and adherence among adult patients with chronic kidney disease undergoing hemodialysis at Dr. Moewardi General Hospital in Surakarta, consistent with previous research by Izzati & Annisha (2016) and Kim et al. (2010). The absence of a

significant gender effect suggests that adherence behavior is influenced by factors beyond biological sex, with both male and female patients facing similar challenges, more strongly determined by shared factors such as socioeconomic status, social support systems, healthcare access, educational background, and individual psychological characteristics, rather than gender-specific traits. While some studies suggested potential gender differences in health-seeking behaviours, such patterns were not evident in the current study population, possibly because the hemodialysis treatment regimen imposes equally demanding requirements on both genders (thrice-weekly sessions, strict dietary restrictions, fluid limitations), potentially overriding any gender-based behavioral differences. This finding has important practical implications: adherence interventions should be designed to address universal barriers and facilitators rather than being differentially tailored by gender, and healthcare providers should focus on individual patient assessment and personalized support strategies accounting for each patient's unique circumstances, resources, and challenges, regardless of gender (Agustina et al., 2021). The relationship between education and compliance of chronic kidney failure patients in undergoing hemodialysis therapy can be seen in table 9.

**Table 9.** Relationship between Education and Compliance of Chronic Kidney Failure Patients in Undergoing Hemodialysis Therapy

| No | Education | Compliant | Non-compliant | *p-value* |
|---|---|---|---|---|
| 1. | No schooling | 2 | 7 | |
| 2. | Elementary school | 7 | 12 | 0,000 |
| 3. | Junior high school | 17 | 6 | |
| 4. | Senior high school | 33 | 2 | |
| 5. | Higher education | 13 | 1 | |
| | **Total** | 72 | 28 | 100 |

The p-value of 0.00 (<0.05) indicates a significant association between educational level and compliance among adult patients with chronic kidney disease undergoing hemodialysis therapy at Dr. Moewardi General Hospital in Surakarta, with all cells in the contingency table having expected frequencies greater than 5, validating the appropriateness of the chi-square test. These results align with research by Agustina et al. (2021) which showed significant relationship between educational level and patient compliance in undergoing hemodialysis, as individuals with lower basic education tend to have difficulty understanding health-related information and pay less attention to health issues, including procedures and benefits of hemodialysis therapy, resulting in their inability to manage chronic diseases optimally and thereby increasing risk of non-compliance in undergoing regular dialysis therapy, aligning with view that individuals with higher educational levels tend to have broader knowledge and are better able to understand information such as compliance in undergoing hemodialysis (Aditya, 2023).

These findings have important implications for patient education interventions in hemodialysis settings, as healthcare providers should develop tailored educational programs that account for patients' varying literacy levels. Lower-educated patients should receive educational materials that use simplified language, visual aids, and hands-on demonstrations to enhance comprehension of hemodialysis procedures and self-care requirements. Implementing teach-back methods in which patients demonstrate

understanding of key concepts can help identify knowledge gaps and reinforce critical information, while regular educational sessions delivered through multiple modalities—including individual counselling, group sessions, and family involvement—may improve treatment adherence across all education levels. Healthcare institutions should consider establishing peer support programs where experienced patients can mentor newly diagnosed individuals, as peer-to-peer learning may be particularly effective for patients with limited formal education who may feel more comfortable learning from others with similar backgrounds and experiences. The relationship between the start time of hemodialysis and compliance of chronic kidney disease patients in undergoing hemodialysis therapy can be seen in table 10.

**Table 10.** Relationship between the Start Time of Hemodialysis and Compliance of Chronic Kidney Disease Patients in Undergoing Hemodialysis Therapy

| No | Start HD | Compliant | Non-compliant | *p-value* |
|---|---|---|---|---|
| 1. | < 1 Year | 30 | 3 | |
| 2. | 1-5 Year | 37 | 14 | 0,000 |
| 3. | > 5 Year | 5 | 11 | |
| | **Total** | 72 | 28 | 100 |

The p-value of 0.00 (<0.05) indicates significant association between hemodialysis initiation and patient compliance among adult patients with chronic kidney disease undergoing hemodialysis therapy at Dr. Moewardi General Hospital in Surakarta, with chi-square test appropriate and all expected cell frequencies exceeding required minimum of 5, aligning with research by Purwati & Wahyuni (2016) which explains that patients undergoing hemodialysis for more than 12 months have low compliance rates. From physical perspective, hemodialysis process imposes substantial physiological burdens including nausea, vomiting, abdominal pain, dizziness, hypotension, muscle cramps, and chills during or after sessions, creating immediate negative reinforcement and treatment fatigue, while time-intensive nature requiring 12-15 hours per week including transportation results in significant physical exhaustion extending beyond dialysis sessions, limiting patients' capacity to maintain daily activities and contributing to overall physical deterioration that paradoxically makes adherence more challenging (Iswara & Mufihatin, 2021). The interaction between physical and psychological domains creates a reinforcing cycle wherein physical symptoms exacerbate psychological distress while psychological factors reduce tolerance for physical discomfort, ultimately resulting in higher non-adherence rates observed in 1-5 year hemodialysis population, and understanding this dual-factor framework is essential for developing comprehensive interventions addressing both physiological symptom management and psychological support to improve long-term adherence outcomes.

**Table 11.** Relationship between Remembering the Hemodialysis Schedule and Compliance of Chronic Kidney Failure Patients in Undergoing Hemodialysis Therapy

| No | Method of Remembering HD Schedule | Compliant | Non-compliant | *p-value* |
|---|---|---|---|---|
| 1. | Hospital schedule | 46 | 20 | 0,475 |
| 2 | Family | 26 | 8 | |
| | **Total** | 72 | 28 | 100 |

The p-value of 0.475 (>0.05) indicates no significant association between the method of remembering the hemodialysis schedule and compliance among adult patients with chronic kidney disease undergoing hemodialysis therapy at Dr. Moewardi General Hospital in Surakarta, with chi-square test assumptions confirmed and expected frequencies in all cells meeting the minimum requirement of 5. This finding aligns with several previous studies including research by Laksono et al. (2019) which found that type of reminder system (hospital-based versus family-based) did not significantly predict hemodialysis adherence ($p > 0.05$), suggesting adherence is more strongly influenced by intrinsic factors such as patient motivation and understanding of treatment importance rather than specific reminder mechanism employed, while Izzati & Annisha (2016) observed that while social support systems—including family reminders—played role in treatment continuity, modality of reminder itself was less critical than overall quality of support network and patient engagement with treatment regimen. These findings collectively suggest that both hospital-established schedules and family-based reminders can be equally effective when patients are adequately motivated and understand importance of maintaining hemodialysis schedule, however, this lack of association may also reflect limited diversity of reminder methods in current study population—with only two categories—and complete absence of technology-based reminder systems such as mobile apps or automated SMS alerts, suggesting future research should investigate whether introduction of diverse reminder technologies might reveal differential effects on adherence, particularly among younger or more digitally literate patient subgroups.

## Integrative Analysis of Adherence Determinants

The bivariate analyses reveal that single isolated factors do not determine hemodialysis adherence but rather emerge from a complex interplay of multiple sociodemographic, clinical, and contextual variables, as age, education level, and duration of hemodialysis demonstrated statistically significant associations with adherence ($p < 0.05$), gender and reminder method showed no significant relationship ($p > 0.05$). These findings should be interpreted holistically rather than in isolation. The significant association between older age (49-60 years) and lower adherence likely reflects not simply chronological age itself but rather convergence of age-related factors including accumulated comorbidities, physical fatigue, reduced adaptability to chronic illness, and potential cognitive decline that collectively compromise treatment adherence, while strong association between lower educational attainment and non-adherence suggests that limited health literacy creates barriers to understanding treatment rationale, recognizing symptom severity, and navigating healthcare systems—barriers further compounded when combined with older age and longer treatment duration.

The relationship between longer hemodialysis duration (1-5 years) and reduced adherence appears paradoxical initially but becomes comprehensible when considered

alongside other variables, as patients in this duration category face dual burden of treatment fatigue and accumulated side effects that may interact synergistically with age-related factors and educational limitations to erode adherence, and notably, patients who are simultaneously older, less educated, and in 1-5 year treatment duration range likely face compounded adherence barriers exceeding sum of individual risk factors, suggesting need for risk stratification approaches identifying patients with multiple concurrent risk factors for targeted intensive interventions rather than addressing single factors in isolation.

The absence of significant associations for gender and reminder method does not imply these factors are irrelevant to adherence support but instead suggests that adherence barriers and facilitators operate similarly across genders, necessitating gender-neutral rather than gender-specific interventions, and that effectiveness of reminder systems depends more on overall patient engagement and support quality than specific reminder modality employed, underscoring that effective adherence interventions must be multi-component, simultaneously addressing educational needs, age-appropriate support mechanisms, duration-specific challenges, and strengthening overall patient activation and family engagement rather than focusing narrowly on single demographic or logistical factors.

## CONCLUSION

This study at Dr. Moewardi General Hospital reveals a 72% hemodialysis adherence rate, identifying age (40–60 years), higher education, and longer treatment duration as key predictors. Conversely, gender and reminder methods showed no significant impact, highlighting the complex nature of patient behavior.

These findings emphasize the need for stratified interventions, particularly intensive support for younger, less-educated patients and those newly initiating therapy. Despite limitations like its cross-sectional design and single-center setting, this research provides vital baseline data for Indonesian tertiary care centers to develop targeted, context-specific support programs that address multifaceted barriers to adherence in chronic kidney failure patients.

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## AUTHOR CONTRIBUTION

MNS : Data collection, data analysis, literature search, manuscript preparation, and manuscript editing.
RR : Ideas, design, manuscript preparation, and manuscript editing.
S : Design, Definition of intellectual content

## ETHICS APPROVAL

This study has been approved by the ethics committee of Dr. Moewardi General Hospital Surakarta with number 202/I/HREC/2025. All participants provided written informed consent before participation. To ensure confidentiality and anonymity, participant identities were protected through the following procedures: (1) respondent names were not recorded on data collection forms; instead, unique identification codes were assigned to each participant, (2) only aggregated group data are reported in research

findings, with no individual-level information disclosed, and (3) all collected data were stored securely with access restricted to authorized research personnel only. These measures ensure that participant information remains confidential throughout the research process and in subsequent dissemination of findings.

## CONFLICT OF INTEREST

None to declare

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