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ORIGINAL ARTICLE

THE EFFECT OF ENERGY CONSERVATION MANAGEMENT ON FATIGUE IN PATIENTS WITH CHRONIC KIDNEY DISEASE UNDERGOING HEMODIALYSIS: A QUASI-EXPERIMENTAL STUDY

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ABSTRACT

Fatigue is the most common complaint among patients with chronic kidney disease (CKD) undergoing hemodialysis. Energy conservation management involves modifying daily activities to reduce energy expenditure and alleviate fatigue. This study examines the impact of energy conservation management on fatigue levels in patients undergoing hemodialysis. This quasi-experimental study involved 52 hemodialysis patients who were randomly assigned to either the intervention or control group. The study was conducted in a hemodialysis unit at a public hospital in West Sumatra, Indonesia, from July to September 2024. The intervention group received energy conservation management training over a six-week period, comprising 12 sessions. Fatigue levels were assessed using the Functional Assessment of Chronic Illness Therapy-Fatigue (FACIT-F) questionnaire. Data analysis was performed using paired and independent t-tests. The results showed a significant reduction in fatigue in the intervention group ($p < 0.001$). The mean (SD) fatigue score decreased from 28.92 (6.14) at baseline to 22.04 (4.41) after the 12 intervention sessions. Furthermore, a statistically significant difference in fatigue scores was observed between the intervention and control groups ($p < 0.001$). Effective energy conservation management reduces fatigue in hemodialysis patients. Nurses can teach this strategy to help patients manage fatigue in daily life.

Keywords: *Energy conservation; fatigue; hemodialysis*

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BACKGROUND

The incidence of chronic kidney disease (CKD) has increased significantly worldwide. In 2017, the World Health Organization (WHO) reported that approximately 697.5 million people were affected by CKD (Luyckx & Stanifer, 2018). According to data from the Indonesian Social Security Agency for Health (BPJS Kesehatan) in 2023, there were 1,501,016 cases of chronic kidney failure nationwide. By 2021, CKD had become the second most common secondary diagnosis within the National Health Insurance program (Nurtandhee, 2023).

Hemodialysis is the most widely used renal replacement therapy due to its accessibility, safety, and effectiveness in managing kidney failure and related emergencies (Yangöz, Turan Kavradım & Özer, 2021). However, despite its benefits, this therapy is associated with various complications, including fatigue, vomiting, headaches, hypotension, muscle cramps, nausea, fever, and chills (Lopez-Sanchez et al., 2019). Among these complications, fatigue is the most commonly reported symptom and significantly affects patients' daily activities and quality of life (Mailani et al., 2022).

Fatigue in hemodialysis patients is frequently associated with malnutrition, anemia, and the physiological burden of CKD, resulting in diminished physical activity and challenges in performing daily tasks (S. Sharma et al., 2022). Fatigue is a subjective experience characterized by physical exhaustion, mental fatigue, and discomfort, all of which contribute to decreased functionality and overall well-being. Factors such as the accumulation of uremic toxins, hemodialysis treatments, and comorbidities further exacerbate fatigue in these patients (Jacobson et al., 2019). Given the high prevalence and detrimental effects of fatigue in CKD patients undergoing hemodialysis, implementing of effective management strategies is essential to improve their quality of life.

Addressing fatigue requires a comprehensive approach that encompasses both behavioral and psychological aspects, including the patient's emotional and mental responses to fatigue (Salomè et al., 2019). This condition is often characterized by significant energy loss, reduced physical strength (such as feeling weak or easily fatigue), and cognitive impairments, including difficulty concentrating, memory problems, and challenges in maintaining emotional stability. These factors contribute to limitations in daily activities, social roles, and overall physical functioning (Hersche et al., 2022; Horigan & Barroso, 2016).

Previous study has identified fatigue as the most common physical symptom experienced by hemodialysis patients, particularly post-dialysis fatigue, which persists over time and limits social engagement and daily activities (Mailani et al., 2022). The study by Parker Gregg et al. (2021) found that 70% of hemodialysis patients report fatigue, with 25% experiencing severe fatigue, often accompanied by dizziness, headaches, loss of appetite, chest pain, and general discomfort. These symptoms interfere with patients' ability to participate in social activities and maintain a sense of normalcy in their daily lives (Farragher et al., 2019). Factors contributing to fatigue in hemodialysis patients include nutritional deficiencies, sleep disorders, physiological changes, abnormal hemoglobin and urea levels, depression, and dialysis-related factors such as low-sodium dialysis solutions and high ultrafiltration rates (Ahmady, Rezaei, & Khatony, 2019). Addressing these causes is crucial to enhancing the well-being and quality of life of individuals undergoing hemodialysis.

National Institute for Health and Care Excellence (NICE) guidelines recommend a multidisciplinary approach that combines education and treatment to address fatigue. One effective strategy is energy conservation education, which has been shown to help patients manage fatigue more effectively (Hersche et al., 2019). Energy conservation management involves identifying and implementing activity modifications to reduce fatigue by optimizing daily tasks at home, work, and other environments. This includes balancing work and rest, modifying activities to conserve energy, delegating tasks, reassessing priorities, using proper body mechanics, optimizing workspace organization, and integrating assistive technology (Blikman et al., 2013). These strategies aim to increase patient participation in daily life, improve task efficiency, and maintain an optimal balance between rest and activity (Farragher et al., 2022).

A previous study by Sharma et al. (2022) demonstrated that energy conservation strategies effectively reduced fatigue levels in hemodialysis patients, improved their quality of life, and alleviated the overall burden of CKD. Following the implementation of energy conservation techniques, patients reported a significant decrease in fatigue and general symptoms. Similar benefits were observed in multiple sclerosis patients; as Fateh et al. (2022) reported that where energy conservation management improved work performance without negatively affecting patients. Given its positive impact, energy conservation has been recommended as part of rehabilitation programs to enhance patients' daily functioning.

Research by Hersche et al. (2022) reinforces the crucial role of energy conservation in alleviating fatigue and improving the quality of life for hemodialysis patients. However, Farragher et al. (2022) reported that while energy conservation strategies may not directly reduce fatigue, they assist individuals accomplish daily tasks and enhance their engagement in life activities. Energy conservation management is a valuable approach for hemodialysis patients, offering practical strategies to optimize energy use and maintain active engagement in daily life.

Reducing fatigue in hemodialysis patients is expected to enhance their participation in daily activities and significantly improve their quality of life. While several studies suggest that energy conservation strategies can help alleviate fatigue, research on energy conservation management specifically in hemodialysis patients remains limited. Therefore, this study aims to examine the effect of energy conservation management on on the fatigue levels of hemodialysis patients.

METHOD

Research design

This quantitative study employs a quasi-experimental, pretest-posttest, two-group design to investigate the effect of conservation energy management on fatigue in hemodialysis patients.

Population and sample

The population in this study comprised all hemodialysis patients at a public hospital in Padang, West Sumatra. The research sample included 52 respondents, divided equally into two groups: 26 in the intervention group and 26 in the control group. Prior to the study, the researchers selected the sample using purposive sampling and measured fatigue level before providing education about energy conservation technique to be applied at home (pre-test). Fatigue measurements were repeated in the sixth week (post-test). The study was conducted from July to September 2024. Inclusion criteria were patients with stage 5 CKD who had undergone hemodialysis for at least three months, were over 18 years old, could understand Indonesian, were willing to participate, and provided informed consent. Exclusion criteria included patients with a history of heart disease, those experiencing cognitive impairment or decreased consciousness (unable to provide information or consent), and pregnant women.

Research Instrument

The instrument used in this study was a respondent demographic questionnaire, which included items such as name, age, gender, education, comorbidities, length of hemodialysis, hemoglobin levels, and the Functional Assessment of Chronic Illness Therapy Fatigue (FACIT-F) questionnaire to measure the respondents' fatigue level. The Indonesian version of the FACIT-Fatigue Scale was employed in this study. This instrument has previously undergone validity and reliability testing among patients with chronic kidney disease receiving hemodialysis. Item validity, assessed using Pearson's correlation, ranged from 0.44 to 0.78. Reliability analysis, based on internal consistency, yielded a Cronbach's alpha coefficient of 0.82.

Data collection

Data collection was conducted in four sequential stages. Eligible participants were initially identified through medical records and consultation with dialysis nurses, then screened according to inclusion and exclusion criteria. Those who met the criteria were informed about the study objectives, procedures, risks, and benefits, and provided written informed consent prior to participation. At baseline (pre-test), all participants in both the intervention and control groups completed a demographic questionnaire, a clinical data form, and the FACIT-F questionnaire. Baseline data were collected during routine hemodialysis sessions in a quiet, and private setting to ensure comfort and confidentiality. The intervention group subsequently received a structured energy-conservation management program over six weeks (12 sessions), while the control group received standard hemodialysis care without additional education. Adherence in the intervention group was monitored using a daily activity checklist completed by participants and reviewed weekly by the researchers. At the end of week six (session 12), fatigue levels in both groups were reassessed using the FACIT-F questionnaire under the same conditions as the baseline assessment.

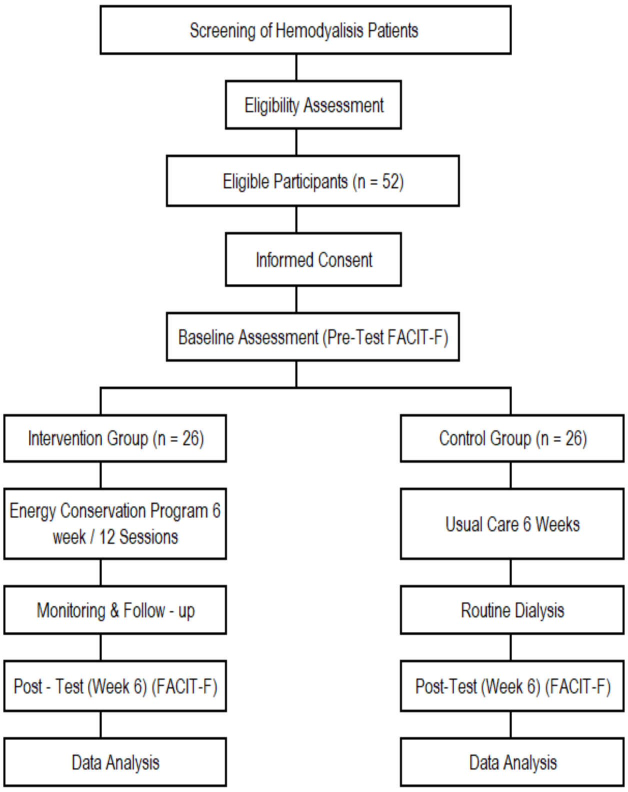

Figure 1 Experimental research flowcharts

Intervention Procedure

Intervention group: In this study, the researchers designed a module to provide a comprehensive understanding of fatigue and energy conservation for patients with CKD undergoing hemodialysis. The module emphasizes the significance of integrating energy conservation strategies into daily life and highlights the role of collaboration with healthcare professionals and family members in supporting patients' well-being. The final section focuses on evaluating and adapting these strategies to meet individual needs (Vatwani and Margonis, 2019; Sharma et al., 2020). Patients were taught several strategies, including prioritizing and organizing daily activities, simplifying tasks, optimizing the activity environment, and utilizing energy-saving equipment. Additional strategies include pacing activities to prevent overexertion, incorporating rest periods throughout the day, effectively communicating daily needs, and maintaining proper body mechanics and posture (Vatwani and Margonis, 2019; Sharma et al., 2020).

The intervention was conducted over 6 (six) weeks, comprising 12 sessions. Before the intervention began, during the first week of session 1, the researchers initiated a cognitive process formation stage with the intervention group by providing education supported by modules. These modules covered the concept of fatigue in CKD patients, the causes of fatigue, why fatigue occurs, and strategies to overcome fatigue in CKD patients. The education was delivered individually at the bedside and lasted 30 minutes. In session 2, researchers continued to develop cognitive processes within the intervention group by focusing on how to deal with fatigue through energy conservation in daily life. This included discussing energy conservation strategies and creating a daily checklist to tailor these strategies to each participant's routine activities. From the second to the third week, spanning session 3 to session 6, the researchers followed up on the education provided and monitored the implementation of energy conservation management strategies at home using the participants' daily activity checklist sheets.

Furthermore, the researchers built the respondents' motivation during the fourth week, specifically in sessions seven and eight. They inquiry about the obstacles the respondents encountered while implementing energy conservation management at home and facilitated the the sharing of their experiences. management. In the fifth week, covering sessions nine to eleven, the researchers conducted follow-ups using a checklist of the respondents' daily activities and provided time for participants to share their experiences. Additionally, in the sixth week, during session twelve, the researchers administered a post-test to all respondents in both the intervention and control groups by distributing the FACIT-F questionnaire.

Control group: In the first week, respondents completed a pre-test by filling out the FACIT-F questionnaire. From session 2 to session 11, respondents underwent hemodialysis as usual without receiving any additional treatment. In the sixth week, during session 12, respondents took a post-test by filling out the questionnaire.

Data analysis

Descriptive statistics were used to summarize participant characteristics. The effects of energy conservation management were examined using bivariate analyses. Data normality was assessed with the Shapiro–Wilk test ($p > 0.05$), and homogeneity of variance was evaluated using Levene's test ($p > 0.05$). For normally distributed data, within-group pre- and post-test comparisons were analyzed using paired *t*-tests, while between-group differences in post-test scores were assessed using independent *t*-tests.

Ethical consideration

Prior to the study, the researcher obtained ethical approval from Dr. M. Djamil Padang Hospital under reference number DP.04.03/D.XVI.XI/284/2024, dated11June 2024. Participants were informed of their right to withdraw from the study without any consequences. Additionally, respondents provided written informed consent to confirm their voluntary participation.

RESULT

All respondents completed the study procedures through the final stage, comprising 26 participants in the intervention group and 26 in the control group. No late symptoms or complications were observed during the study. To assess the distribution of data for each variable, tests for homogeneity and normality were conducted. As shown in Table 1, the study included 52 participants, evenly divided into two groups: a control group and an intervention group, each with 26 respondents. Variables such as age, hemoglobin (HB) levels, and duration of hemodialysis were comparable between the two groups (p > 0.05). The control group had a slightly higher mean (SD) age of 52.69 (13.21) years compared to 49.00 (14.50) years in the intervention group. HB levels were marginally lower in the control group, with a mean (SD) of 7.98 (1.19), compared to 8.20 (0.79) in the intervention group. The duration of hemodialysis was also slightly longer in the control group, averaging 37.65 (28.58) months, compared to 36.46 (28.66) months in the intervention group. Fatigue levels were higher in the control group, with a mean (SD) of 29.23 (6.07), versus 28.92 (6.14) in the intervention group.

In terms of demographics, 65.4% of the control group and 13% of the intervention group were male. The majority of participants had a high school education, with a higher percentage in the control group (55.3%) compared to the intervention group (50%). Hypertension was the most common comorbidity, affecting 46.2% of participants in both groups. Homogeneity tests confirmed that the intervention and control groups were equivalent in terms of age, gender, education level, comorbidities, haemoglobin levels, duration of hemodialysis, and fatigue levels prior to the intervention. This equivalence ensured a balanced comparison between the two groups.

Table 1. Homogeneity Test Based on the Categorical Data of Respondents' Characteristics.

Characteristics	Control (n=26)		Intervention (n=26)		p-value
	n (%)	Mean (SD)	n(%)	Mean (SD)	
Age (year)		52.69(13.208)		49.00(14.500)	0.342
Sex					
Female	9 (34.6)		13 (50)		
Male	17 (65.4)		13 (50)		0.270
Education					
Primary School	2 (7.7)		1 (3.8)		
Junior High School	1 (3.8)		4 (15.4)		
High School	18 (69.2)		13 (50)		1.000
University	5 (19.2)		8 (30.8)		
Comorbidities					
None	3 (11.5)		5 (19.2%)		
Hypertension	12 (46.2)		12 (46.2)		
Diabetes Mellitus	6 (15.4)		6 (23.1)		0.418
Hypertension+Diabetes Mellitus	4 (15.4)		2 (7.7)		
Uric Acid	1 (3.8)		1 (3.8)		
Hb levels		7.98 (1.119)		8.20 (0.794)	0.427
Duration of Hemodialysis (Month)		37.65(28.584)		36.46 (28.658)	0.881
Fatigue		29.23(6,068)		28.92(6,144)	1.000

**Significant at α = 0.05, with independent t-test*

Mean difference in fatigue scores between pre-test and post-test following energy conservation management

Table 2 presents the results of the paired sample t-test, revealing that the mean fatigue score in the intervention group was 28.92 (SD = 6.144) at pre-test and 22.04 (SD = 4.413) at post-test, with a p-value of 0.001, indicating a statistically significant difference between pre-test and post-test scores within this group. In contrast, the control group exhibited a mean fatigue score of 29.23 (SD = 6.068) at pre-test and 27.88 (SD = 4.227) at post-test, with a p-value of 0.200, suggesting no significant difference between pre-test and post-test scores in this group. Furthermore, the results indicated a statistically significant difference in fatigue scores between the pre-test and post-test assessments overall. The intervention group showed a greater reduction in fatigue compared to the control group (p < 0.001), as presented in Table 3. This study suggests that the implementation of energy conservation management effectively decreases fatigue scores.

Table 2. Fatigue scores before and after energy conservation management

Variable	Group	mean	SD	MD (95% CI)	T	df	p Value
Fatigue Scale	**Intervention**						
	Before	28.92	6,144	1.040 (4.743 to 9.026)	6.622	25	0.001*
	After	22.04	4,413				
	Control						
	Before	29.23	6,068	1.02273 (-0.76020 to 3.45251)	1.316	25	0.200
	After	27.88	4,227				

**significant at p<0.05 with paired t-test*

Table 3. Differences in mean fatigue Scores after management conservation energy and Differences in fatigue score between the intervention and control groups

Variable	Group	mean	SD	MD (95% CI)	t	df	p Value
Fatigue Scale	**After**						
	Control	27,88	4,227	-5.846 (-8.253 to -3.439)	-4.878	50	<0,001*
	Intervention	22,04	4,413				
	Difference						
	Control	0.769	5.566	6.07692 (3.062-9.091)	4.049	50	<0,001*
	Intervention	6.846	5.2512				

**significant at α 0.05, with independent t-test*

DISCUSSION

This study aimed to investigate the effects of energy conservation and energy management on fatigue levels in hemodialysis patients. This results reported that the mean fatigue score in the intervention group decreased significantly after implementing energy conservation management, from 28.92 to 22.04 (p = 0.001), indicating a statistically significant difference between pre-test and post-test scores within this group. In contrast, the control group exhibited a slight decrease in mean fatigue score, from 29.23 to 27.88 (p = 0.200), showing no significant difference between pre-test and post-test scores in this group.

Fatigue is a prolonged feeling of exhaustion that can significantly diminish a person's physical and mental vitality, impairing their ability to perform daily activities. Numerous factors factors—including body weight, nutrition, medications, sleep patterns, general physical and mental health, and preexisting medical conditions—influence this subjective experience (Vatwani & Margonis, 2019). Furthermore, causing physical exhaustion, fatigue can also disrupt cognitive functions such as memory retention and focus, making it difficult for individuals to manage their daily tasks efficiently (Carandang, Poole, & Connolly, 2022; Tsirigotis et al., 2022).

The energy conservation management theory proposes that enhancing life participation in individuals with chronic fatigue can be achieved by reducing fatigue levels during daily tasks. A previous study by Sharma et al. (2022) revealed that implementing strategies for energy conservation significantly reduced fatigue, improved patients' quality of life, and did not cause severe adverse effects.

Fatigue in individuals undergoing hemodialysis is influenced by various behavioral and physiological factors, including physical activity levels, sleep patterns, and reduced daily activity. Furthermore, fatigue can negatively impact work productivity, household responsibilities, education, social interactions, and self-care (Hersche et al., 2022). A previous study by Farragher et al. (2019) highlighted that patients with end-stage CKD often identify fatigue as one of the most significant barriers to life participation, impacting their ability to engage in meaningful daily activities.

A study showed that fatigue in patients CKD was significantly associated with age, education level, employment status, comorbidities, duration of hemodialysis, systolic blood pressure, hemoglobin levels, interdialytic weight gain (IDWG), and health literacy (Mailani et al., 2025). In addition to physiological factors, treatment-related factors such as post-dialysis malaise, dialysis adequacy, and composition of dialysis solution also contribute to fatigue (Farragher et al., 2019). A decline in erythropoietin production due to kidney dysfunction leads to anemia, which manifests as fatigue, weakness, depression, and cognitive impairment (Lemone et al., 2016). Addressing fatigue is crucial for enhancing the quality of life in hemodialysis patients, as persistent fatigue can significantly limit daily participation, reduce productivity, and negatively impact overall well-being (Hersche et al., 2019; Sharma et al., 2022).

According to the National Institute for Health and Care Excellence guidelines, a multidisciplinary approach is essential for effectively managing fatigue. This approach includes exercise therapy, self-management strategies, patient education, and the use of appropriate medications. Energy conservation management is recognized as a beneficial intervention within this framework (Hersche et al., 2019). Research by Fateh et al. (2022) demonstrated that energy conservation management can effectively reduce fatigue over the medium term while improving work performance. Similarly, Hersche et al. (2019) reported that this approach significantly lowers fatigue scores in both the short and long term.

Hemodialysis patients face lifelong reliance on dialysis machines, malnutrition, and anemia, all of which contribute to persistent fatigue that affects their daily functioning. If not managed effectively, this fatigue can lead to worsening health conditions and a decline in the patient's quality of life (Ritianingsih, Nawati, & Nurhayati, 2023). Fatigue in hemodialysis patients is multifactorial and is often associated with decreased energy levels and generalized body exhaustion (Fateh et al., 2022).

Energy conservation strategies are designed to enhance life participation among individuals experiencing fatigue by providing techniques to preserve and efficiently distribute energy throughout daily tasks. Farragher et al. (2022) highlighted that appropriate energy management strategies enable patients to maintain daily routines at home, work, or within their community while minimizing fatigue. Implementing these strategies can help individuals sustain their activity levels without exacerbating exhaustion (Vatwani & Margonis, 2019).

The results of this study demonstrated a significant decrease in fatigue levels among patients in the intervention group following the implementation of energy conservation management. These findings align with the study by Ziaeirad and Shahnazari, (2019), which reported a significant reduction in fatigue scores among participants following one month of energy conservation intervention. However, Farragher et al. (2022) suggested that although this approach increases participation in daily activities, its impact on reducing fatigue scores may not be very noticeable.

The intervention involved applying seven straightforward energy conservation strategies, including prioritizing activities, organizing tasks, delegating responsibilities, maintaining proper body mechanics, and incorporating rest periods throughout the day (Farragher et al., 2019). Improved energy management supports daily functioning, as fatigue adversely impacts self-care activities (e.g., personal hygiene, dressing) and other essential tasks such as work, cooking, cleaning, and socializing (S. A. Sharma et al., 2020).

Statistical analysis revealed a significant reduction in fatigue scores in the intervention group following the implementation of the energy conservation management program. This finding aligns with Naraphong and Barton (2023), who reported high participant satisfaction and good adherence to the intervention. Improved fatigue management may enhance patients' ability to engage in self-care and comply with treatment regimens. Importantly, energy conservation strategies are non-pharmacological and low-risk, reducing the likelihood of overexertion or symptom exacerbation. Therefore, this intervention supports patient adherence while promoting safety in fatigue management.

The six-week duration of energy conservation management in this study was associated with a significant reduction in fatigue among patients undergoing hemodialysis, suggesting that sustained intervention may be necessary to achieve measurable improvements in fatigue. Another study, with a three-week intervention reported by Farragher et al. (2022), found that energy conservation enhanced life participation but did not result in a significant reduction in fatigue, possibly due to the shorter intervention period. However, Hersche et al. (2019) demonstrated that energy conservation strategies were effective in reducing fatigue in both short-term (three weeks) and long-term (six weeks) interventions, with greater improvements observed over longer durations. Collectively, these findings suggest that while short-term programs may improve functional engagement, longer intervention durations may be more effective in reducing fatigue.

By balancing activity and rest, energy conservation management helps reduce bodily strain, optimize energy expenditure, and ultimately decrease fatigue levels (Ritianingsih et al., 2023). Naraphong and Barton, (2023) further emphasized that this intervention is one of the most effective non-pharmacological strategies for managing fatigue. Similarly, Fateh et al. (2022) found that energy conservation supports fatigue management and enhances work performance. Notably, the intervention produced positive outcomes without adverse effects, ensuring that participants remained engaged in the study.

In a study conducted by Ziaeirad and Shahnazari (2019), it was found that a program focusing on energy conservation management helps patients better organize, plan, and divide physical activities. This program provides an understanding of how to modify daily routines, assess activity patterns, and make wise choices to improve energy utilization and reduce fatigue (Shafaey et al., 2023).

This study shows that energy conservation management reduces fatigue in patients undergoing hemodialysis. According to Herschel et al. (2022), energy conservation management appears to lower fatigue levels in hemodialysis patients, improve their quality of life, and facilitate their participation in daily activities. This research is essential as it provides empirical evidence on how integrating energy conservation management into daily life can effectively alleviate fatigue in hemodialysis patients.

A limitation in this study is the challenge in monitoring compliance with energy conservation measures implemented in the patient's home. Compliance was assessed through patient-completed observation sheet, by the patient and assisted by family members, and monitored via reminders sent through WhatsApp. Furthermore, researchers conducted follow-ups during patients' hemodialysis sessions at the hospital.

However, no direct observations were made at the patients' homes.

CONCLUSION AND RECOMMENDATION

Energy conservation management had a significant effect on reducing fatigue and improving the quality of life of hemodialysis patients by helping them regulate energy use through structured daily activities. After six weeks of implementation, patients were able to use their energy more efficiently, organize activities better, and participate more optimally in daily life. These findings indicate that energy conservation management is a practical and effective nursing intervention that can be integrated into routine hemodialysis care and institutional nursing guidelines.

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CONFLICT OF INTEREST

The authors confirm that they have no conflicts of interest to disclose.

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