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# Programmed Physical Exercise Increase Muscle Strength and Reduce Fatigue of Patient Undergoing Hemodialysis

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*Abstract*

*Hemodialysis is one of the treatments used to treat people with chronic kidney disease. Often, hemodialysis causes muscle weakness and fatigue that can interfere with daily activities. Programmed physical exercise can improve muscle strength and fatigue, thereby improving the quality of life of patients with chronic kidney disease. This study contributed to evaluating the effect of programmed physical exercise on muscle strength and fatigue in patients undergoing hemodialysis to contributed evidence based recomendations for nursing interventions in hemodialysis care. A quasi-experimental study with a pretest-posttest with control group design was conducted. The sample was selected using a purposive sampling technique, resulting in 48 respondents divided into a control group and an intervention group. Muscle strength was measured using a handgrip dynamometer, and fatigue was measured using the FACIT fatigue scale. Data were analyzed using the Mann-Whitney test. The mean value of muscle strength in the control group was 15.96 and the mean value of the intervention group was 33.04 (p-value = 0.000). The mean value of fatigue in the control group was 17.25, and the mean value of the intervention group was 31.75 (p-value = 0.000). Programmed physical exercise significantly improves physical function by enhancing muscle strength and decreasing fatigue among hemodialysis patients. This study contributes to nursing practice by supporting the integration of strucctured by physical exercise programs into routine hemodialysis care. Nurses are recommended to educate, guide, and monitor patients in performing programmed physical exercises as part of standard nursing interventions to optimize patient outcomes and quality of life.*

***Keywords:*** *Fatigue; Hemodialysis; Muscle strength; Physical exercise*

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## 1. Introduction

Renal function gradually deteriorates over months or years (Visweswaran et al., 2020). As a chronic illness, chronic kidney disease (CKD) is regarded as a serious global health concern (Ghafourifard et al., 2021). Hemodialysis is one of the treatments used to treat people with CKD (Perez-Dominguez et al., 2021). The majority of patients with CKD get home peritoneal dialysis (PD) or in-center hemodialysis (HD) three times a week (Suri et al., 2023). For patients with CKD, hemodialysis will prevent death. However, hemodialysis does not cure or restore kidney disease. Patients will still experience a number of problems and complications, as well as various changes in the form and function of the body's systems (Darsini et al., 2022).

Patients undergoing hemodialysis often experience a significant decline in physical function, including muscle weakness and fatigue, which greatly affects quality of life (Ghafourifard et al., 2021). In hemodialysis patients, the decline in muscle strength and function is a consequence of a combination of mechanisms such as oxidative stress, systemic catabolic responses, and metabolic alterations that lead to muscle atrophy and imbalanced protein dynamics. This process not only reduces muscle mass but also contributes to clinical symptoms such as severe fatigue, as patients with muscle weakness are significantly more likely to report intense fatigue compared to those with better muscle strength (Heitman & Alexander, 2024; Shi et al., 2024; Yang et al., 2024)

Intradialytic exercise, particularly structured physical training programs conducted during dialysis sessions, has emerged as a promising non-pharmacological strategy to counteract these adverse effects. Research indicates that such exercise interventions can significantly enhance muscle strength, reduce fatigue, and improve overall physical function in hemodialysis patients (Sri et al., 2024). Wayunah et al (Wayunah et al., 2023) found that intradialytic exercise was able to reduce fatigue level.

Despite the growing body of evidence supporting the benefits of intradialytic exercise, its implementation remains limited, particularly in low-resource settings such as Indonesia. Barriers to exercise participation include fatigue, fear of injury, and lack of support from healthcare providers. Addressing these challenges through structured, culturally appropriate, and feasible exercise programs is crucial for improving the health outcomes of hemodialysis patients.

This study aims to determine the effect of programmed physical exercise on muscle strength and fatigue of patients undergoing hemodialysis. The findings could inform the development of tailored interventions that enhance patient well-being and quality of life in the Indonesian.

## 2. Method

**Study Design and Participant**

This research is quasi-experimental study with pretest-posttest with control group design. This study was conducted in the hospital dialysis installation.

The study population consisted of 78 patients undergoing hemodialysis. The sample included 48 patients was selected using a purposive sampling technique based on specific inclusion and exclusion criteria.

The inclusion criteria were : undergoing hemodialysis routinely twice a week, not experiencing nervous system disease (neurology), not experiencing musculoskeletal disorders, not experiencing hemodialysis complications (hypotension, cramps, headaches/dizziness), no femoral access installed, not experiencing hemodynamic disorders, and permitted by the doctor to do physical exercise during hemodialysis.

**Procedures**

Forty eight respondents devided into a control group and an intervention group. The control group the action taken were routine actions or self performed movements that are usually done when undergoing hemodialysis. The control group had muscle strength and fatigue measured on day 1 and in the fourth week. Meanwhile, the intervention group involved administering 30 minutes of physical exercise, which was carried out twice a week for four weeks, and will be monitored by taking measurements in the second and fourth weeks.

**Muscle strength and fatigue measurement**

Muscle strength was measured using a handgrip dynamometer (Camry®) by asking the respondent to hold the handgrip dynamometer with a straight arm position beside the body without touching the body, and the respondent is asked to pull the handgrip dynamometer handle with full force without jerking, maximum contraction 2-4 seconds. Muscle strength will be indicated by a scale and expressed in kilograms (kg).

Fatigue was measured using the Fatigue Assesment Chronic Illness Therapy (FACIT) fatigue scale. The FACIT Fatigue Scale is part of Health Related Quality of Life (HRQoL) questionnaires aimed at addressing chronic diseases through measuring the body's functional systems. The FACIT Fatigue Scale contains 13 questions using a Likert scale of 0-4. All questions are calculated using an interval scale to obtain a minimum score of 0 and a maximum score of 52. The higher a person's fatigue score, the better quality of life and a score < 30 indicates severe fatigue.

**Statistical analysis**

Data analysis was conducted using SPSS version 25. The demographic data such as age, gender, education, job and length of service are presented in the form of frequency distribution. Before conducting statistical test, the researcher first conducted a data normality test using the Shapiro Wilk test. The results of the normality test using the Shapiro Wilk test showed that the data was not normally distributed. So the statistical testing was continued with a non parametric test. Data were analyzed with The Mann Whitney test to compare the mean differences between the control and intervention groups.

**Statement**

This research has been approved by the Researh Ethics Committee of Universitas Pekalongan with number 024/B.02.01/KEPK/III/2024.

## 3. Results and Discussion

The baseline characteristics of the study patients were presented in Table 1. In total 48 patients were included, among which 56.20% were female. The majority of age of patients were 46-65 years old (70.80%) and mostly graduate from elementary school (37.50%). Additionally, 56.30% respondents job at home or retired. 68.80% respondents had been undergoing hemodialysis for less than 2 years.

In this study, respondents were predominantly female (Table 1). Recent research indicated that the role of gender in CKD risk is complex and cannot be considered in isolation. Gender differences in CKD prevalence and progression are influenced by a combination of socio-demographic characteristics, behavioural and lifestyle patterns, and ethnic background, rather than gender alone. Genetic susceptibility, including specific allelic variants associated with CKD progression, further modulates individual risk, and environmental and racial factors contribute additional variance in disease susceptibility and outcomes (Shen et al., 2024; Wu et al., 2021). The relationship between gender-related factors and CKD has been infrequently investigated. A research project found that housekeeping,a task traditionally assigned to women, is linked to increased prevalence of CKD in middle to low-income nations relative to individuals who were used (Vosters et al., 2025).

**Table 1.** Demography Data (n=48)

| Variable | Category | n | % |
|---|---|---|---|
| Gender | Male | 21 | 43.80 |
| | Female | 27 | 56.20 |
| Age | 12 – 25 years old | 3 | 6.30 |
| | 26 – 45 years old | 11 | 22.90 |
| | 46 – 65 years old | 34 | 70.80 |
| Education | Elementary school | 18 | 37.50 |
| | Junior high school | 9 | 18.80 |
| | Senior high school | 14 | 29.20 |
| | Undergraduate programme | 7 | 14.60 |
| Job | Requires muscle | 11 | 22.90 |
| | Requires brain | 10 | 20.90 |
| | At home/ retired | 27 | 56.30 |
| Length of time undergoing hemodialysis | ≤ 2 years | 33 | 68.80 |
| | >2 years | 15 | 31.20 |

The most common age group is 46-65 years. Aging affects the anatomy, physiology, and cytology of the kidneys. After the age of 30, the kidneys atrophy, and the thickness of the renal cortex decreases by approximately 20% per decade. Other changes that occur with age include thickening of the glomerular basement membrane, expansion of the glomerular mesangium, and deposition of extracellular matrix proteins, leading to glomerulosclerosis (Hsieh & Power, 2009). However, this study also included respondents aged 12-25 years who had CKD and required hemodialysis. This means that CKD can affect people of any age. The effect of programmed physical exercise on muscle strength and fatigue in patients undergoing hemodialysis are presents in Tables 2 and 3.

Based on Table 2, the mean value of muscle strength in the control group was 15.96 kgs, and the mean value of the intervention group was 33.04 kgs. There was a difference of 17.08 kgs. The p-value = 0.000 < α (0.05), so it can be concluded that there is an effect of programmed physical exercise on muscle strength in patients undergoing hemodialysis.

**Table 2.** The effect of programmed physical exercise on muscle strength in Patients undergoing hemodialysis (n=48)

| Variable | Groups | n | Mean Rank | p-value |
|---|---|---|---|---|
| Muscle strength | Control | 24 | 15,96 | 0,000 |
| | Intervention | 24 | 33,04 | |

These findings align with physiological theories that suggest regular physical activity can improve muscle strength, capillarization, and muscle metabolism, particularly in populations with chronic conditions such as hemodialysis patients (Deligiannis et al., 2021). Programmed physical exercise can help reduce muscle atrophy caused by immobilization and the side effects of repeated hemodialysis therapy (Yin et al., 2024).

The increase in muscle strength in the invention group demonstrates that, despite the catabolic nature of hemodialysis therapy, exercise-based interventions still provide significant physiological benefits. This suggests that physical exercise should be part of comprehensive management for hemodialysis patients, taking into account each individual's medical condition.

Patients receiving peritoneal and extracorporeal dialysis may see positive improvements in their body composition, muscular mass and strength, and functional ability if exercise programs are implemented (Deligiannis et al., 2021).

**Table 3.** The effect of programmed physical exercise on fatigue in Patients undergoing hemodialysis (n=48)

| **Variable** | **Groups** | **n** | **Mean Rank** | **p-value** |
|---|---|---|---|---|
| Fatigue | Control | 24 | 17,25 | 0,000 |
| | Intervention | 24 | 31,75 | |

The mean fatigue value in the control group was 17.25 kgs, and the mean fatigue value in the intervention group was 31.75 kgs. There was a difference of 14.40 kgs (Table 3). The p-value = 0.000 < α (0.05), so it can be concluded that there is an effect of programmed physical exercise on fatigue in patients undergoing hemodialysis.

Fatigue is one of the most frequently reported non-specific symptoms by hemodialysis patients and significantly impacts their quality of life and daily activity levels. Structured and regular physical exercise has been shown to increase functional capacity, reduce fatigue, and improve psychological well-being in patients with chronic kidney disease undergoing hemodialysis.

In this research, the increase in the fatigue value to 31.75 kgs in the intervention group likely represents an increase in the ability or resistance to fatigue, meaning that patients are able to perform physical activities with higher loads or intensities before experiencing fatigue. This is in line with research by Xianying et al., (2024) which stated that a combination of aerobic and resistance training during dialysis sessions can increase physical activity tolerance and reduce the perception of fatigue significantly compared to the control group.

These findings have important clinical implications. Chronic fatigue can lead to decreased quality of life, increased dependence on others, and even depression. Therefore, non-pharmacological interventions such as programmed physical exercise could be part of the standard care protocol for hemodialysis patients. Regular implementation of an exercise program not only helps reduce fatigue but also contributes to improved muscle strength, cardiorespiratory capacity, and mental health.

Recent evidence suggests that exercise interventions tailored specifically for hemodialysis patients not only improve muscle strength but also reduce systemic inflammation, which is often elevated in chronic kidney disease. According to Yin et al. (2024), structured exercise therapy demonstrated a significant reduction in markers of muscle atrophy, highlighting its role in preserving musculoskeletal health. These findings support the notion that physical activity is not merely supplementary but essential in the holistic management of patients undergoing dialysis.

Furthermore, exercise has been shown to positively impact cardiovascular outcomes in dialysis patients. Deligiannis et al. (2021) reported that both aerobic and resistance training improved vascular health, reducing the risk of cardiovascular morbidity, which remains the leading cause of mortality in this population. Integrating programmed exercise into routine care may therefore address both musculoskeletal and cardiovascular complications simultaneously.

Another crucial aspect is the psychological benefit derived from exercise. Patients with chronic kidney disease frequently report depression, anxiety, and low quality of life. A systematic review by Wayunah et al. (2023) revealed that intradialytic exercise reduced fatigue-related distress and improved psychological well-being, ultimately leading to better adherence to treatment. This emphasizes the dual role of exercise in enhancing both physical and mental health outcomes.

Importantly, exercise interventions during dialysis sessions (intradialytic exercise) offer a practical approach, as patients are already in a clinical setting where they can be monitored by healthcare professionals. Sri et al. (2024) confirmed that such supervised programs were safe, feasible, and yielded superior results in terms of functional capacity compared to unsupervised activities at home. This underscores the importance of institutional support and structured implementation for sustained patient benefits.

From a broader perspective, patient-centered exercise programs could also contribute to reducing healthcare costs by minimizing hospitalizations and complications related to immobility. A network meta-analysis by Xianying et al. (2024) concluded that resistance and combined training modalities were most effective in improving fatigue tolerance, which directly correlates with reduced dependency and improved self-care abilities. These findings suggest that exercise should be standardized as a routine part of dialysis care across healthcare systems.

The role of programmed physical exercise in reducing fatigue is increasingly being recognized as a core element of dialysis care. Ghafourifard et al. (2021) emphasized that patients' perception of the benefits of exercise strongly correlated with their health-related quality of life. Those who perceived exercise as beneficial were more likely to participate consistently and report lower levels of fatigue, underscoring the necessity of education and counseling as part of exercise interventions.

In addition to its physical and psychological benefits, programmed exercise has been shown to improve patients' social engagement. Patients who are able to maintain better physical endurance and energy levels are more likely to engage in family and community activities. This finding was highlighted in a multicenter trial by Perez-Dominguez et al. (2021), which demonstrated that structured exercise during hemodialysis improved not only physical function but also daily activity levels, thereby reducing social isolation.

Another important dimension is exercise adherence, which is often a challenge in chronic disease management. Suri et al. (2023) developed a simplified exercise program for end-stage kidney disease patients and found that its simplicity increased patient compliance. This suggests that interventions must be both clinically effective and practically feasible, particularly in low-resource healthcare systems.

Gender-related differences in chronic kidney disease outcomes also warrant attention in relation to exercise. Vosters et al. (2025) identified gender-related characteristics that influence the prevalence of CKD, which may also affect participation in physical activity. Tailoring exercise programs to address cultural and gender-specific barriers may enhance inclusivity and improve outcomes across diverse patient populations.

Moreover, combining aerobic and resistance exercise appears to be superior compared to a single-modality program. Xianying et al. (2024) concluded that hybrid exercise regimens achieved better results in terms of fatigue reduction and endurance. This supports the development of individualized, multimodal exercise prescriptions as part of standard dialysis care.

Longitudinal studies further confirm the sustainability of benefits derived from exercise. Deligiannis et al. (2021) reported that patients who continued programmed exercise over several months maintained improvements in both cardiovascular and skeletal muscle health. These findings highlight the importance of continuity and integration of exercise into long-term dialysis treatment plans.

Finally, advances in telehealth and digital monitoring open new possibilities for supporting dialysis patients in exercise adherence outside the clinical setting. Yin et al. (2024) noted that remote exercise supervision could help patients maintain training regimens, especially those with limited access to hospital-based programs. This innovation aligns with global trends in digital health and could further enhance the scalability of exercise interventions for CKD patients.

## 4. Conclusions and Suggestions

The results of this study indicated that there was an effect of programmed physical exercise on muscle strength and fatigue in patients undergoing hemodialysis. Therefore, it is recommended that hemodialysis patients perform programmed physical exercises independently to increase muscle strength and reduce fatigue.

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