The Effects of a 12-Week Intradialytic Exercise Program Static and Dynamic Stretching Combining with Resistance Training on Muscle Strength, and Quality of Life Hemodialysis Patients with Chronic Kidney Disease: A Randomize Controlled Trial

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ABSTRACT

Background: Muscle strength may have an effect on quality of life in older people undergoing haemodialysis (HD) for chronic kidney diseases . Elderly dialysis patients with chronic kidney diseases are more likely to become feeble as a result of a cumulative loss of muscle mass and physical function, which is hastened by the uremic environment and aging-related muscle loss. decreased quality of life. Haemodialysis patients encounter alterations in their daily routine, a reduction in their physical capabilities, and a reliance on ongoing treatment. One type of nursing intervention program that is necessary to reduce side effects during dialysis therapy is intradialyticexercise (IDE) on the patient's lower limbs to enhance muscular function. **Purpose of** this study to determine the effects of video-based intradialytic exercises education on the muscular strength, the functional balance, and the muscle endurance of haemodialysis patients. Haemodialysis patients encounter alterations in their daily routine, a reduction in their physical capabilities, and a reliance on continuous care. One example of a nursing intervention program that is necessary to reduce side effects during dialysis therapy is the use of intradialytic Exercise (IDE) on the patient's lower limbs to enhance muscular function. **Methods:** A quantitative Randomized Control Trial study design was used in this research. A total of 96 respondents were gathered, with 48 respondents assigned to each group based on inclusion criteria. Among the requirements for inclusion are being able to converse in Indonesian, being between the ages of 18 and 70, and having undergone HD for at least three months. **The results** Comparing the video-based exercises intervention to the control group, the former showed a substantial improvement in hip, femoral, and leg muscular strength. In comparison to the control group, the strength of the legs grew by 17.6%, the femur by 10.2%, and the hip by 7.09%. Between the pre-test and post-test, the intervention group's quality of life score increased noticeably. **Conclusion** the study highlights the need of taking into account both the possible advantages and drawbacks of using video-based intradialytic exercises to enhance general health and wellbeing. To enhance patient health, interadialytic exercise can be implemented as a regular practice in the HD unit.

Introduction

Chronic Kidney Diseases/CKD is a major global public health concern, and its socioeconomic costs are predicted to rise significantly in the future, with a large increase in its socioeconomic cost expected in the future (Zelko et al., 2019a). It is widely acknowledged that CKD is linked to increased mortality and an increased likelihood of cardiovascular disease (Kang et al., 2020). Moreover, the major cause of CKD worldwide is diabetes, and this trend is expected to continue driving up the global CKD burden (CDC, 2019). Some of this increased burden is expected to occur in Asia, which is home to nearly 4.5 billion people, or 60% of the world's population. (Liyanage et al., 2022). CKD prevalence ranged from 7.0% to 34.3% across Asia, with most cases in China and India (299.9 million) (Liyanage et al., 2022). Up to 65.6 million people may have end-stage kidney disease (stages 4-5) out of the total number of patients with CKD (Liyanage et al., 2022). Indonesia has a significant burden of CKD. However, there is a lack of reliable information about the prevalence of CKD in Indonesia. Increase from 2.0% in 2013 to 3.8% in 2018 in the prevalence of CKD (eGFR60 ml/min/1.73 m2) was reported by theNational Basic Health Research (Riset Kesehatan Dasar, Riskesdas). The prevalence of CKD in 2021 was 0.5%. The most common co-occurring condition was hypertension (40.8%), followed by diabetes mellitus (3.3%), cardiovascular disease (2.6%), stroke (1.6%), and hepatitis (0.5%). Despite the prevalence of hypertension, only 36.2% of patients had a prescription for anti-hypertensive drugs, and only 21.7% of those patients actually took the medication as advised. Higher rates of CKD are seen in male hepatitis patients who also have diabetes (Hustrini et al., 2022).

Hemodialysis (HD) is the most common renal replacement therapy procedure that improves symptoms and preserves life for individuals with CKD (Queeley, G. L., & Campbell, 2018). Because of the nature of the disease, CKD patients need regular renal replacement therapy sessions, have multiple physical, psychological, social, and economic problems. On top of the burden, Patients with dialysis are experienced high level of stress similar to patients with chronic diseases; sometimes even more stress than others chronic disease (D'Onofrio et al., 2017; Taheri-Kharameh et al., 2016). Study showed that lifestyle changes and patient dependent on a machine for survival could lead to issues such as depression, resignation, and anxiety (Shin, S. J., & Lee, 2018). Furthermore, hemodialysis complications (i.e., hypotension, headache, and air embolism) can lead to a decreased capacity to work and adversely affect individual productivity (Ganu et al., 2018).

In recent decades, the survival rate of dialysis patients has significantly increased due to an improved awareness of hemodialysis and related implications. In initial HD sessions, patients experience poor physical strength (Johansen et al. 2023), muscle metabolism (Checherit et al. 2020) and peak oxygen consumption (VO2 peak) and have a high mortality risk (Sietsema et al. 2019). However, studies have shown that patients on dialysis have a poor quality of life that influenced by physical, biological, psychological, social and cultural factors (Ganu et al., 2018; Teles et al., 2018). Moreover, the quality of life (QOL) reduces.

HD treatment causes reduced muscle strength, mass, physical performance, and increase mortality (Ribeiro et al., 2022).Furthermore, active daily living reliance predicted mortality in all hemodialysis patients (Ino et al., 2022). Frailty, sarcopenia, and low physical function are more prevalent than in the general population. (Otobe et al., 2022). HD therapy involves two or three times, four- to five-hour sessions per week of inactivity (Melo et al., 2019). Daytime sedentary behaviorlasting more than three hours is linked to hospitalization, specialized care, and various co-morbidities (Melo et al., 2019). HD patients cannot exercise due to dietary limitations and dialysis access (artery-vein fistula, graft, or catheter). These negative patient behaviors were associated to lower and upper extremity muscle dysfunction (Yeh et al., 2020). Thus, routine physical function testing in HD patients is underutilized but crucial. HD patients who exercise safely have a better prognosis (F. Ferrari et al., 2020). Exercise prescription and increased daily physical activity should be adapted to HD patients' functional performance and independence (Wilund et al., 2021). Those with HD who participate in exercise interventions may see gains in their quality of life, risk factors for cardiovascular disease, and measures of renal and physical function. Despite these findings, HD patients have not generally adopted exercise routines, and physical inactivity and low physical function remain hallmarks of the disorder globally (Wilund et al., 2021). Exercise effects are also mixed. Patients' dialysis adequacy measures, body composition, and haematologyprofile have improved (Liao et al., 2016).

METHODOLOGY

2.1 Research Design and research type

Design of this study was randomized controlled trial with pre-test post-test repeated measurement in two group (intervention and control group), conducted in Central Hospital Fatmawati, south Jakarta Indonesia. Recruitment started in May 2024 and the follow-up continued until August 2024 one type of experiment involves gathering information from participants before and after implementing a physical activity intervention, as in this design. The purpose of this research was to examine the effects of intradialytic exercise training on muscular strength, muscle endurance, functional balance, and quality of life. The intervention was 12-weeks intradialytic exercise training and control group. Measurements were carried out twice, namely before treatment (T0) and immediately after intervention (T1).

The research design is depicted in the following figure:

Pre-test T0
Group 1: Intervention
12 weeks intradialytic SS, DS combine resistance
Post-test 1 M (T1), at 12weeks

Pre-test T0
Group 2: Control
Post-test 1 M (T1)

Figure 3. 1 Study Design

SS (Static Stretching) and DS (Dynamic Stretching)

12weeks intradialytic SS, DS

2.2 Participan: recruited a total participants of 78, with 39participants assigned to the intervention group and 39 to the control group. The study taken place in, Jakarta public hospital (renal unit Fatmawati Hospital), Fatmawati hospital is publick Hospital with specify Orthopedic rehabilitation met **Inclusion criteria**: Patient aged above 18 to 70 years old, Patient undergoing HD 2 times times perweek at least three month, Able to communicate Indonesian Language, Stable blood pressure <210/110mmHg, pulse, 60-98 perminute and respiration in normal range 16-24 times per minute

INTERVENTION

Pre- Intervetion

After conducting a thorough analysis of the literature, the research team created the content for the mobile application. The investigator recruited, organized, and readied. Following approval by the Hospital Institutional Review Board Ethical Committee, the researcher created protocol documentation. For the current study, the researcher and two trained assistants wore identification cards bearing their names, titles, university affiliations, and photos. Volunteers are informed by researchers about the objectives, advantages, and low risk of the study. You won't be penalized for leaving the study, and the results will remain private. Questions are welcome from participants. The researcher or trained assistant asked individuals to fill out the informed consent form and provide their cell phone number if they accept. The research assistant gave patients a card in a sealed envelope with a random number to group them. The research assistant opened the sealed envelope and record control or intervention group.

Intervention Phase

The video content designed for intradialytic exercises should comprehensively guide patients undergoing haemodialysis to safely and effectively perform exercises aimed at improving muscle strength, muscle endurance, functional balance, and quality of life. Below is a structured description of the video components:

Intervention group who receive resistance training

Intradyalitic exercise treatments included Stretching (static and dynamic) and resistance exercise. The second hour of dialysis was for exercise. Static stetching Involves holding a stretch in a challenging but comfortable position for a period, usually 15–60 seconds. **Purpose**: It lengthens specific muscles and improves flexibility and range of motion. Dynamic stretching involves moving parts of your body through a full range of motion in a controlled way, often resembling movements in sports or daily activities. Benefit of Dynamic stretching Increases blood flow, warms up the muscles, and prepares the body for more intense exercise. The program increased the maximum training time from 30 to 60 minutes. Patients' workouts matched their fitness levels. Participants in the first, second, classified as "very low," "low," and "moderate," respectively. Cardiovascular risk factors customized exercises. Five minutes of warming up low intensity, 15 mean exercise moderate intensity, 10 minutes of resistance training, and 5 minutes of cooling make up a typical workout. With the covering, the fistula arm remained immobile. Arms with AV fistula did not get any work outs.

a. **Warm-Up**

The warm-up starting deep breathing, left, right, and forward head movements were observed, as well as a rotation 90 degrees, flexy right and left of the head.SComprised upper and lower extremity flexibility/stretching. Upper extremity, static stretching continue your workout by flexing and extending your fingers, rotating your wrists clockwise and counterclockwise, flexing and extending your wrists, elbows, and shoulders. Lower extremity the leg warm-up ended with a series of flexion/extension rotation including the toes, ankles, knees, and hips.

Main Exercise (stretching, flexing, resistance)

Constant leg movements back and forth,up and down, hand raises and lowers, knee bends and straightens, knee rotations, and side to side leg movements were all part of the aerobic exercises that were performed to the beat paster than warm up. The patients have to move their arms and legs in time with the music's tempo. Heart rates were maintained at 50%-60% of maximum in the very low intensity group, 60%-65% in the low intensity group, and 65%-70 in the moderate group by modifying the aerobic training intensities (TI).

b. **Resistance Training**

Body weight, elastic terra bands, and semi-recumbent core strength exercises were all used in resistance training. For the resistance training, we did the chest press, shoulder press, triceps extension, straight arm shoulder flexion, shoulder horizontal abduction, seated row, supine grip, prone grip, neutral grip, bicep curl, leg abduction, plantar flexion, dorsi flexion, straight leg/bent knee raise, knee extension, and knee flexion using Thera band

Post-12 weeks intervention

Following the conclusion of the session, the researchers utilized a dynamometer to measure muscle strength, the Borg scale to measure respiratory function, blood pressure, pulse, sit-to-stand-to-sit test, time up and go test, and assessment right after the intervention.

Result

The results show changes in muscle strength across three muscle groups—leg, femoral, and hip—before and after in control group (Figure 4.4). For leg muscle strength, the number of patients classified as having normal strength decreased from 8 pre-test to 7 post-test. Similarly, the number of patients in the good category reduced from 11 pre-test to 10 post-test, while those with fair

Score improvement in muscle strength in pre and post on intervention compare on control group was tested using paired t test as shown in Figure 4.5 to Figure 4.7 and Table 4.8.

The mean score of leg muscle strength in intervention group was 135.67±68.57 at baseline and increased to 215.92±77.91 at posttest. Mean of femoral muscle strength was also increased from 108.31±50.96 at baseline to 157.90±58.19 at posttest. Then, mean of hip muscle strength increased from 105.92±48.38 at baseline to135.38±44.05 at posttest.

Discussion

The results of this study align with the growing body of literature demonstrating that intradialytic exercises can significantly enhance muscle strength among patients undergoing hemodialysis. Specifically, the improvements reported—such as a 17.6-point increase in leg muscle strength, 10.2-point improvement in femoral muscle strength, and 7.09-point enhancement in hip muscle strength relative to controls—are consistent with recent research findings on the benefits of resistance and video-based exercise interventions. Intradialytic exercise (IDE), which integrates physical activity into dialysis sessions, addresses the loss of muscle mass and strength that is common in patients with CKD. IDE programs using both traditional resistance exercises and non-immersive virtual reality games have been shown to improve lower-limb muscle strength, functional capacity, and overall physical fitness (Pans-Alcaina et al., 2024). These programs are effective because they maintain patient engagement during the otherwise sedentary dialysis sessions and promote neuromuscular adaptations that enhance muscle performance over time (García-Maset et al., 2024). The significant gains in muscle strength reported in this study are critical, as they address the deconditioning effects associated with prolonged hemodialysis. Research suggests that IDE can mitigate the loss of lean tissue mass while improving patient mobility and quality of life (Pans-Alcaina et al., 2024). Improvements in hip and leg strength, for instance, are essential for daily activities such as walking, sitting, and stair climbing, which can ultimately reduce the risk of falls—a significant concern among dialysis patients (García-Testal et al., 2024).These findings align with earlier research that explored the use of resistance training during dialysis. Resistance-based IDE programs have consistently demonstrated improvements in knee and hip flexor strength and leg endurance, further supporting the effectiveness of structured exercise in this setting (Tayebi et al., 2024). Notably, these exercises also contribute to better cardiovascular health and psychological well-being, which are often compromised in patients undergoing long-term dialysis (Pans-Alcaina et al). There has been a lot of study looking at the effects of intradialytic exercise on quality of life, and the findings have been mixed, especially when it comes to the effects of various types of exercise. Several exercise prescriptions must be investigated to see which one is most beneficial for hemodialysis patients if we are to comprehend the influence of intradialytic exercise on their quality of life. Although a recent meta-analysis (Chung et al., 2018) indicates that hemodialysis patients may find relief from fatigue and depression through regular exercise, additional randomized controlled trials focusing on different exercise programs are needed. While it is true that hemodialysis patients' morphological, physiological, and functional outcomes improve as a consequence ofexercise, how long it takes to keep these gains even after training stops is unclear. This break, also called detraining, may cause the adaptations and performance that were produced by training to be lost, in whole or in part, as stated by Gravina et al. (2019). This happens to varying degrees depending on factors including the quantity and quality of sleep.Results from a study done in 2020 by Rosa and colleagues confirmed what was already known: that patients' health and quality of life are both enhanced by fitness training as they undergo hemodialysis treatments.

Conclusion

Dynamic stretching combined with resistance trainingoffers greater benefits in terms of improving muscle strength, cardiovascular health, functional mobility, and overall quality of life for dialysis patients. **Static stretching** primarily helps with flexibility and relaxation but is less effective at improving strength, endurance, or cardiovascular health compared to dynamic exercises and resistance training. A combination of both stretching types within an intradialytic exercise program may yield the most comprehensive benefits, In order stretching is frequently utilized in sports and clinical settings to increase muscle-tendon extensibility and maximal joint range of motion (ROM), human skeletal muscle The extensive research has not shown that chronic treatments have an impact on the mechanical properties of muscle-tendon units, despite the general consensus that chronic stretching—that is, particular repeated sessions over weeks—increases maximal range of motion. Quality of life in the intervention group also increased significantly from pre-test to post-test, contrasting with the control group, which showed no significant improvements.

In conclusion, the findings reveal that video-based intradialytic exercises produced significant enhancements in leg muscle strength, femoral muscle strength, and hip muscle strength compared to the control group. These results emphasize the importance of evaluating both the potential benefits and the limitations of video-based intradialytic exercises for improving overall health and well-being.

Recommendation

Evidence suggests that intradialytic resistance training improves day-to-day functioning by raising awareness of visual details, but not by altering indicators of behavior linked to altruism and social interaction. The ecological setting in which intradialytic resistance exercise happens in the everyday lives of HD patients has to be better understood. The positive effects of intradialytic resistance exercise on clinical relevance are supported by our empirical data. More importantly, experts and the general public failed to consider the possible negative consequences of intradialytic resistance exercise. Clinicians and researchers should be encouraged to consider the possible negative consequences of intradialytic resistance exercise.

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